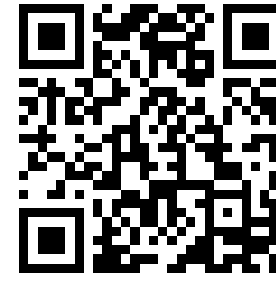
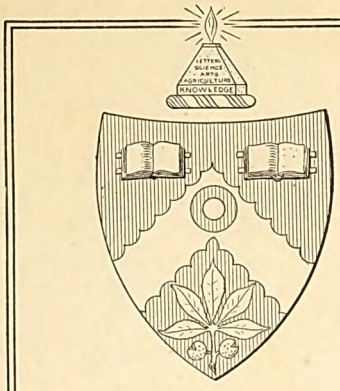
This is a reproduction of a library book that was digitized by Google as part of an ongoing effort to preserve the information in books and make it universally accessible.

Google™ books

https://books.google.com





LIBRARY *of the*
OHIO STATE
UNIVERSITY

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Cape of Good Hope. Royal observatory.
"
D-5

ANNALS

OF THE

CAPE OBSERVATORY.

VOLUME I.

Published by order of the Lords Commissioners of the Admiralty in obedience to Her Majesty's Command.

LONDON:
PRINTED FOR HER MAJESTY'S STATIONERY OFFICE,
BY EYRE AND SPOTTISWOODE,
PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

And to be purchased, either directly or through any Bookseller, from
EYRE AND SPOTTISWOODE, EAST HARDING STREET, FLEET STREET, E.C., and
32, ABINGDON STREET, WESTMINSTER, S.W.; or
JOHN MENZIES & Co., 12, HANOVER STREET, EDINBURGH, and
90, WEST NILE STREET, GLASGOW; or
HODGES, FIGGIS, & Co., LIMITED, 104, GRAFTON STREET, DUBLIN.

1898.
Price Two Shillings.

Digitized by Google

QB 4
C23
v.1

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.
VOL. I.

PREFACE.

THE publications of the Royal Observatory at the Cape of Good Hope have hitherto consisted of annual volumes (containing chiefly the separate results of meridian observations) and of general catalogues of stars; these publications will be continued in their present form.

But memoirs depending on special researches or investigations continued over a series of years cannot be conveniently included in annual volumes, and may be more suitably presented in a separate series of publications. The Annals of the Cape Observatory have been established to provide such a series.

My original intention was to reserve Part 1 of the First Volume of these Annals for a history and description of the Cape Observatory.

But experience showed that the page-size (demi-quarto) which had been adopted for printing Parts 2, 3, and 4 of Vol. I. was inconveniently small for many purposes, and particularly so for an illustrated description of an observatory.

It was finally decided to change the size of future volumes of these Annals to royal quarto, to complete Vol. I. by publishing as Part 1 of Vol. I. the Observations of Comets made between 1879 and 1894 (for which the smaller page is perfectly suitable) and to relegate the history and description of the Observatory to a separate volume of the Annals.

Part 2 of Vol. II. was, by mistake, printed of the same size as Vol. I. A new title-page is issued herewith to transform Part 2 of Vol. II. (as at present issued) into Part 5 of Vol. I., and it is assumed that it will be bound in this way.

Vol. II., as thus amended, will contain—

Part 1 (already issued).—"An Account of the Cape Observations of the Great Comet of 1882."

Part 2.—A Reference Catalogue of Southern Double Stars.

Parts 3 and 4.—Investigations with the Zenith Telescope.

Vols. III., IV., and V. contain the Cape Photographic Durchmusterung.

a (3)1957. 400.—7/98. Wt. 21119.

751307

Digitized by Google

Vols. VI. and VII. contain a Determination of the Solar Parallax and Mass of the Moon from Heliometer Observations of the Minor Planets, *Iris*, *Victoria*, and *Sappho*.

Vol. VIII. will contain further investigations with the Heliometer, including Determinations of the Parallax of the 1st Magnitude Stars of the Southern Hemisphere.

A History and Description of the Observatory will probably be given in Vol. IX.

DAVID GILL.

Royal Observatory,
Cape of Good Hope,
1897, December 7.

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

CONTENTS OF VOL. I.

PART 1.—*Observations of Comets*, 1880—1894.

PART 2.—*An Account of Telegraphic Operations connecting Aden and the Cape of Good Hope, in the years* 1881 *and* 1882, *by David Gill.*

PART 3.—*Telegraphic Determinations of the Longitudes of Lorenço Marques* (*Delagoa Bay*), *Mozambique, and Zanzibar, and the Longitude of Quilimane, by W. H. Finlay.*

PART 4.—*Occultations of Stars by the Moon observed at the Royal Observatory, Cape of Good Hope, in the years* 1834 *to* 1880.

PART 5.—*On the variations of the Instrumental Adjustments of the Cape Transit Circle, by W. H. Finlay.* (*This was originally issued as Part* 2 *of Vol. II.; a new title-page is issued herewith to transform it, for reasons stated in the Preface, into Part* 5 *of the present volume*).

Errata. *See* next page.

Digitized by Google

ERRATA.

PART 4.—*For* 1835 to 1880 throughout *read* 1834 to 1880.

„ p. 34, Rot^{n}. No. 73 *for* + ·790 *read* + ·970.

„ p. 42, Rot^{n}. No. 215 *for* — 8·80 *read* — ·880.

„ p. 52, Rot^{n}. No. 340 *for* — ·046 *read* + ·046.

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.
VOL. I., PART 1.

OBSERVATIONS OF COMETS

MADE AT THE

ROYAL OBSERVATORY, CAPE OF GOOD HOPE,

IN THE YEARS

1880 TO 1894.

UNDER THE DIRECTION OF

DAVID GILL, C.B., LL.D., F.R.S., HON. F.R.S.ED., &c.,
HER MAJESTY'S ASTRONOMER AT THE CAPE.

Digitized by Google

OHIO STATE
UNIVERSITY

Digitized by Google

INDEX.

			Page
INTRODUCTION			1
Comet.			
1880	I.	7-inch Equatorial, Ring Micr., 5 nights; Filar Micr., 1 night	3
1881	III.	4-inch Heliometer, 6 nights	4
1881	IV.	4-inch Heliometer, 15 nights; 7-inch, 13 nights	5
1882	I.	7-inch Equatorial, 38 nights	7
1884	I.	7-inch Equatorial, 43 nights	10
1884	II.	7-inch Equatorial, 29 nights	13
1884	III.	7-inch Equatorial, 26 nights	15
1885	III.	7-inch Equatorial, 6 nights	17
1886	I.	7-inch Equatorial, 31 nights	18
1886	II.	7-inch Equatorial, 18 nights	21
1886	V.	7-inch Equatorial, 13 nights	22
1886	VI.	7-inch Equatorial, 32 nights	23
1886	VII.	7-inch Equatorial, 34 nights	25
1886	IX.	7-inch Equatorial, 4 nights	27
1887	I.	Finder of 6-inch Equatorial, 6 nights	27
1887	IV.	7-inch Equatorial, 12 nights	28
1888	I.	7-inch Equatorial, 17 nights; Heliometer, 5 nights	29
1888	II.	7-inch Equatorial, 5 nights	32
1889	IV.	7-inch Equatorial, 7 nights	32
1891	I.	7-inch Equatorial, 3 nights	33
1891	IV.	7-inch Equatorial, 1 night	34
1892	I.	7-inch Equatorial, 14 nights	34
1892	VI.	7-inch Equatorial, 22 nights	35
1893	II.	7-inch Equatorial, 14 nights	36
1893	III.	7-inch Equatorial, 15 nights	37
1894	II.	7-inch Equatorial, 15 nights	38
1894	III.	7-inch Equatorial, 5 nights	39

Digitized by Google

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.
VOL. I., PART 1.

INTRODUCTION.

THIS work contains the observations of all comets (except 1882 II.) observed here during the years 1880—1894. The observations of the Great Comet of 1882 will be found in Vol. II., Part 1, of the Cape Annals.

The general rule adopted has been to observe only such comets as could be observed at the Cape with more advantage than in the Northern Hemisphere.

Most of these observations have already appeared, in a more or less imperfect form, in the Monthly Notices of the Royal Astronomical Society, or in the *Astronomische Nachrichten*; that is to say, the places of the comets there given were reduced with the best star-positions available at the time. In the majority of cases the stars have since been observed with the transit circle, and the reductions have now been carried out with improved star-places.

When, however, the authority for a star's place is one of the annual volumes, 1880—1890, the declination used in this volume requires a small correction for flexure and co-latitude.

From 1880—1885, Feb., the co-efficient of horizontal flexure - = $0''.462$
From 1885, Dec.—1889, Dec. - - - - - = $0''.303$
If co-latitude—

$$123^\circ\ 56'\ 3''.35$$

be adopted (*cf.* Cape General Catalogue, 1885), the corrections to be applied to the declinations of stars taken from the annual catalogues and adopted in this volume are given in the following table:—

1881—1885, Feb.

Dec.	Corr.	Dec.	Corr.
°	"	°	"
+20	−0·52	30	−0·18
15	−0·50	35	−0·14
10	−0·47	40	−0·10
+ 5	−0·44	45	−0·06
0	−0·41	50	−0·02
− 5	−0·37	55	+0·02
10	−0·34	60	+0·05
15	−0·30	65	+0·09
20	−0·26	−70	+0·12
25	−0·22		

1885, Dec.—1894, Dec.

Dec.	Corr.	Dec.	Corr.
°	"	°	"
+20	−0·39	30	−0·17
15	−0·38	35	−0·14
10	−0·36	40	−0·12
+ 5	−0·34	45	−0·09
0	−0·32	50	−0·07
− 5	−0·30	55	−0·04
10	−0·27	60	−0·02
15	−0·25	65	+0·01
20	−0·22	−70	+0·03
25	−0·20		

Digitized by Google

All the comets were observed with the 7-inch equatorial, with the exception of 1881 III., which was observed with Dr. Gill's 4-inch heliometer and of 1887 I., which was observed with the finder of the 6-inch equatorial. Comet 1881 IV. was observed with the 4-inch heliometer; and Comet 1888 I. with the 7-inch heliometer, as well as with the equatorial.

A full description of the 7-inch heliometer will be found in Vol. VII. of the *Annals of the Cape Observatory.*

The introduction of the Repsold micrometer and illuminating apparatus for the 7-inch equatorial in 1882 greatly increased the ease and accuracy of observation of faint objects. A description of this apparatus will be found in the *Encyclopædia Britannica*, Art. "Micrometer," figs. 20 and 21.

In observing, the position circle was always adjusted carefully so that some fairly-bright star in the neighbourhood of the comet ran along the movable wire. The comet and some convenient comparison star were allowed to cross the field by the diurnal motion, and differences of declination were determined with the movable wire. The position circle was then turned through 90°, and observations of difference in right ascension were made. The power used was 90.

The necessary corrections for refraction have been applied, but all results are uncorrected for parallax. The values of $p\,\Delta$ have been computed on the assumption that the sun's parallax is 8″·85.

In most cases it will be seen that the differences of R.A. and dec. of comet and star are given for the same instant of Cape mean time. These differences were in all cases taken separately, but so arranged that the mean of the times for $\Delta\,\alpha$ was nearly coincident with the mean of the times for $\Delta\,\delta$. A small correction, deduced from the observations themselves, or from an ephemeris, then sufficed to reduce one mean to the epoch of the other.

The value of a revolution of the screw was determined several times and frequently checked.

The observations have been made by Dr. Gill, Mr. W. H. Finlay, Dr. W. L. Elkin, and Mr. R. T. Pett.

Comet 1886 VII. (periodic) was discovered by Mr. Finlay, and Comet 1881 I. by Mr. Sawerthal, both at the Cape Observatory.

DAVID GILL.

Digitized by Google

COMET, 1880 I.

OBSERVATIONS WITH 7-INCH EQUATORIAL.

Date.	Cape Mean Time.	Comet's Apparent R.A.	Log. $p\,\Delta$	No. of Obs.	Comet's Apparent Dec.	Log. $p\,\Delta$	No. of Obs.	Comp. Star.
1880.	h m s	h m s			° ′ ″			
Feb. 10 -	8 50 2	0 3 58·62	9·7697	3				1
	8 52 49				−33 43 15·7	0·6245$_n$	2	1
11 -	8 33 4	0 20 21·77	9·7671	4				2
	8 45 42	0 20 31·49	9·7691	4	−33 31 31·1	0·5937$_n$	4	3
12 -	8 42 18	0 36 27·63	9·7651	5	−33 11 30·5	0·5644$_n$	4	4
	8 42 18	0 36 28·29	9·7651	5	−33 11 23·5	0·5644$_n$	5	5
13 -	8 30 57	0 51 39·32	9·7558	7	−32 44 20·9	0·5366$_n$	5	6
14 -	8 23 5	1 6 7·89	9·7442	1	−32 11 17·2	0·4828$_n$	1	7
	8 42 51	1 6 19·30	9·7538	3	−32 10 53·1	0·5274$_n$	3	8
	8 42 51	1 6 19·23	9·7538	3	−32 10 53·2	0·5274$_n$	3	9
15 -	8 24 31	1 19 54·83	9·7365	10	−31 32 52·4	0·4707$_n$	10	10

The observations on February 10 were made with the parallel wire micrometer; on all the other dates with a ring micrometer. The observers were Messrs. Gill and Finlay.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1880·0.	Dec. 1880·0.	Authority.
	h m s	° ′ ″	
1	0 2 32·83	−33 42 17·2	Cape, 1885, Cat. No. 12.
2	0 17 33·77	−33 31 56·1	Cape, 1885, Cat. No. 64.
3	0 21 58·45	−33 40 11·5	Cape, 1880, Cat. No. 163.
4	0 34 32·48	−33 13 4·2	Cape, 1885, Cat. No. 86.
5	0 41 50·65	−33 6 49·0	Cape, 1885, Cat. No. 95.
6	0 57 41·58	−32 43 25·4	Cape, 1880, Cat. No. 410.
7	0 56 42·44	−32 11 53·7	Cape, 1880, Cat. and Melbourne.
8	1 7 49·12	−32 12 37·5	Cape, 1885, Cat. No. 124.
9	1 11 9·48	−32 2 29·0	Cape, 1885, Cat. No. 126.
10	1 17 55·79	−31 34 17·3	Cape, 1880, Cat. No. 540.

Digitized by Google

COMET, 1881 III.

OBSERVATIONS WITH 4-INCH HELIOMETER.

Date.	Cape Mean Time.	Observer.	Distance.	Position Angle.	No. of Obs.	Comet—Star. Δ α	Comet—Star. Δ δ	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Comp. Star.
1881.	h m s		″	° ′	α δ	′ ″	′ ″	° ′ ″		° ′ ″		
May 31	6 19 24	E	2057·3	177 27·6	4-4	+ 1 44·7	−34 15·2	75 46 29·2	0·927	−29 42 17·1	0·620$_n$	1
June 1	6 8 51	E	1578·3		2-0				0·920		0·612$_n$	1
3	5 53 47	E	3561·8	96 40·7	4-4	+65 48·6	− 6 54·2	76 12 26·9	0·912	−26 25 44·1	0·612$_n$	2
4	6 27 4	E	1495·2	215 1·9	2-2	−15 56·8	−20 24·4	76 12 42·6	0·914	−26 24 0·9	0·658$_n$	3
5	5 59 57	E	3544·0	354 2·0	4-4	− 6 48·4	+58 44·7	76 21 51·1	0·909	−25 4 51·6	0·631$_n$	4
8	5 48 9	E	4586·6		2-0				0·890		0·658$_n$	5
9	5 31 18	E	2514·8	30 58·3	4-4	+22 26·6	+35 56·3	77 16 23·5	0·881	−15 44 54·3	0·674$_n$	6
9	18 3 8	E	1393·6	38 15·9	4-4	+14 51·8	+18 14·2	77 23 45·9	0·878$_n$	−14 26 33·0	0·672$_n$	7

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1881·0.	Dec. 1881·0.	Authority.	Star's Red. to App. Place.
	° ′ ″	° ′ ″		″ ″
1	75 44 42·0	−29 8 0·4	Cape, 1885, Cat. No. 345 - -	+ 2·5 −1·5 + 2·6 −1·3
2	75 6 34·0	−26 18 49·6	Stone, 2226 - - -	+ 4·3 −0·3
3	76 28 35·0	−26 3 35·6	Stone, 2264 - - -	+ 4·4 −0·9
4	76 28 35·0	−26 3 35·6	Stone, 2264 - - -	+ 4·5 −0·7
5	78 23 14·4	−18 15 28·6	Cape, 1885, Cat. No. 358 - -	+ 8·7 −0·7
6	76 53 47·3	−16 20 50·6	Stone, 2301 - - -	+ 9·6 0·0
7	77 8 43·8	−14 44 47·2	Cape, 1885, Cat. No. 352 - -	+10·3 0·0

Digitized by Google

COMET, 1881 IV.

RESULTS OF OBSERVATIONS WITH 4-INCH HELIOMETER.

Date.	Cape Mean Time.	Observer.	Distance.	Position Angle.	No. of Obs.	Comet—Star.		Comet's Apparent R.A.	Log. $p\Delta$	Comet's Apparent Dec.	Log. $p\Delta$	Comp. Star.
						$\Delta\alpha$	$\Delta\delta$					
1881.	h m s		"	° ′	α δ	m s	′ "	h m s		° ′ "		
Aug. 31	7 9 56	E	173·4	192 30·8	4-4	−0 2·58	− 2 49·2	13 22 36·00	9·667	+14 21 56·5	0·739$_n$	α
31	7 15 17	G	207·1	182 43·3	4-4	−0 0·68	− 3 26·8	13 22 37·90	9·671	+14 21 18·9	0·734$_n$	α
Sept. 1	6 39 23	E	3352·4	280 8·4	4-4	−3 44·45	+ 9 50·2	13 30 0·15	9·629	+11 30 48·0	0·747$_n$	β
1	6 53 39	G	3275·6	278 16·3	4-4	−3 40·46	+ 7 51·2	13 30 4·14	9·644	+11 28 49·0	0·742$_n$	β
3	6 30 4	G	1613·2	289 21·6	4-4	−1 42·06	+ 8 54·8	13 42 46·32	9·605	+ 6 14 5·6	0·727$_n$	γ
3	6 41 15	E	1552·7	287 30·8	4-4	−1 39·29	+ 7 47·2	13 42 49·09	9·618	+ 6 12 58·0	0·726$_n$	γ
6	6 40 38	E	4091·3	275 19·6	4-4	−4 31·58	+ 6 19·8	13 57 31·43	9·611	− 0 22 40·7	0·688$_n$	ε
6	7 11 51	E	5027·4	228 16·6	4-4	−4 10·16	−55 45·9	13 57 36·98	9·645	− 0 25 14·7	0·690$_n$	δ
7	6 38 14	E	3070·4	260 32·5	4-4	−3 22·06	− 8 24·6	14 1 29·72	9·608	− 2 15 18·4	0·674$_n$	ξ
7	6 55 0	G	3042·4	259 7·7	4-4	−3 19·34	− 9 33·8	14 1 32·44	9·628	− 2 16 27·6	0·678$_n$	ζ
8	6 46 34	G	2972·0	77 27·7	4-4	+3 13·90	+10 45·2	14 5 7·65	9·621	− 4 0 8·1	0·666$_n$	η
8	7 1 42	E	2991·3	78 43·7	4-4	+3 16·08	+ 9 44·7	14 5 9·83	9·637	− 4 1 8·6	0·668$_n$	η
9	7 17 4	E	926·8	164 32·4	4-4	+0 16·58	−14 53·3	14 8 28·41	9·653	− 5 38 39·0	0·662$_n$	θ
9	7 34 58	G	993·9	163 32·0	4-4	+0 18·87	−15 53·2	14 8 30·70	9·667	− 5 39 38·9	0·668$_n$	θ
12	6 43 17	G	1265·0	80 7·6	4-4	+1 24·31	+ 3 36·9	14 16 38·01	9·626	− 9 46 2·5	0·621$_n$	ι
12	6 56 59	E	1279·5	81 59·3	4-4	+1 25·72	+ 2 58·3	14 16 39·42	9·642	− 9 46 41·1	0·628$_n$	ι
14	6 49 24	G	2671·5	355 9·2	4-4	−0 15·41	+44 21·9	14 21 5·32	9·641	−12 5 12·7	0·607$_n$	κ
14	7 4 18	E	2628·4	355 27·7	4-4	−0 14·20	+43 40·2	14 21 6·53	9·656	−12 5 54·4	0·617$_n$	κ
15	7 5 54	E	1910·3	126 52·1	4-4	+1 44·63	−19 6·2	14 23 5·36	9·662	−13 8 40·8	0·611$_n$	λ
15	7 20 50	G	1941·4	127 27·3	4-4	+1 45·51	−19 40·6	14 23 6·24	9·674	−13 9 15·2	0·622$_n$	λ
19	6 53 57	G	2414·7	128 11·4	4-4	+2 11·96	−24 53·0	14 29 43·61	9·665	−16 42 45·7	0·581$_n$	μ
19	7 9 31	E	2450·9	128 34·3	4-4	+2 13·24	−25 28·1	14 29 44·89	9·677	−16 43 20·8	0·594$_n$	μ
21	7 18 49	G	2303·6	264 25·2	4-4	−2 40·89	− 3 44·0	14 32 30·93	9·693	−18 13 27·2	0·601$_n$	ν
21	7 35 43	E	2297·8	263 35·0	4-4	−2 40·24	− 4 16·8	14 32 31·58	9·701	−18 14 0·0	0·619$_n$	ν
23	7 51 16	G	611·3	160 57·1	4-4	+0 14·11	− 9 37·8	14 35 0·37	9·712	−19 34 45·9	0·631$_n$	ξ
23	8 4 52	E	641·1	161 1·0	4-4	+0 14·75	−10 6·2	14 35 1·01	9·715	−19 35 14·3	0·645$_n$	ξ
24	7 10 55	G	3329·5	301 50·3	4-4	−3 21 22	+29 16·4	14 36 7·38	9·697	−20 11 7·3	0·583$_n$	ο
24	7 26 21	E	3305·7	301 24·9	4-4	−3 20·74	+28 43·0	14 36 7·86	9·706	−20 11 40·7	0·602$_n$	ο
27	7 16 4	E	364·7	277 17·7	4-4	−0 25·99	+ 0 46·3	14 39 17·81	9·710	−21 53 27·9	0·589$_n$	π
27	7 38 33	G	356·2	272 42·1	4-4	−0 25·56	+ 0 16·7	14 39 18·24	9·718	−21 53 57·5	0·619$_n$	π

Digitized by Google

COMET, 1881 IV.

RESULTS OF OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Comp. Star.
1881.	h m s	m s	′ ″			h m s		° ′ ″		
Sept. 30	7 12 3		− 0 56·4	3	G			−23 23 3·4	0·586$_n$	a
	7 18 13	−2 18·56		6	G	14 42 6·94	9·719			a
Oct. 1	7 9 48		− 7 2·7	6	E			−23 50 41·3	0·584$_n$	b
	7 10 9	−0 6·68		12	E	14 42 59·18	9·718			b
2	7 14 45	−0 31·00		6	E	14 43 51·60	9·713			c
	7 19 10		+ 4 7·5	1	E			−24 17 32·4	0·599$_n$	c
3	7 17 49	−1 3·21		4	E	14 44 42·06	9·716			d
	7 18 44		+14 50·7	5	E			−24 42 59·2	0·601$_n$	d
4	7 11 51	−0 14·63		6	E	14 45 30·65	9·717			d
	7 19 57		−10 11·1	5	E			−25 8 1·0	0·606$_n$	d
7	7 12 14	+0 51·36		8	E	14 47 52·64	9·724			e
	7 25 33		− 2 52·8	5	E			−26 17 44·2	0·621$_n$	e
10	7 22 44	+0 13·21		8	G	14 50 6·78	9·741			f
	7 23 22		− 2 2·1	4	G			−27 21 24·9	0·627$_n$	f
11	7 19 41	+0 22·01		12	E	14 50 49·89	9·743			g
	7 20 12		− 6 45·3	6	E			−27 41 27·1	0·625$_n$	g
12	7 21 41		− 2 22·5	4	E			−28 1 11·6	0·631$_n$	h
	7 27 40	+0 17·08		9	E	14 51 33·92	9·744			h
14	7 31 7	+2 47·98		10	G	14 52 58·31	9·746			i
	7 35 9		+ 1 36·1	6	G			−28 39 5·6	0·609$_n$	i
16	7 19 2		− 5 58·7	2	G			−29 15 27·7	0·622$_n$	l
	7 24 59	+0 17·50		3	G	14 54 21·01	9·748			l
17	7 22 30		− 2 44·5	4	G			−29 32 42·7	0·609$_n$	m
	7 30 47	−2 18·18		10	G	14 55 2·45	9·749			m
18	7 27 21		+ 6 49·5	1	G			} −29 49 52·2	0·607$_n$	n
	7 27 21		+ 3 14·1	1	G					o
18	7 32 3	+3 3·17		3	G }	14 55 42·52	9·749			n
	7 32 3	+2 56·60		3	G }					o

Notes.

Oct. 2. Comet faint through fog: pointing in declination uncertain.
Oct. 16. Comet barely visible.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1881·0.	Dec. 1881·0.	Authority.	Star.	R.A. 1881·0.	Dec. 1881·0.	Authority.
	h m s	° ′ ″			h m s	° ′ ″	
α	13 22 36·56	+14 24 53·4	Three obs., Cape, 1882.	π	14 39 40·72	−21 54 2·8	Three obs., Cape, 1882.
β	13 33 42·51	+11 21 5·5	,, ,,	b	14 43 3·27	−23 43 27·2	Four obs., Cape, 1882.
γ	13 44 26·20	+ 6 5 19·1	,, ,,	a	14 44 22·91	−23 21 55·7	Three obs., Cape, 1882.
δ	14 1 44·83	+ 0 30 39·9	,, ,,	c	14 44 20·00	−24 21 28·7	,, ,,
η	14 1 51·41	− 4 10 43·5	,, ,,	d	14 45 42·68	−24 57 38·6	,, ,,
ϵ	14 2 0·70	− 0 28 51·5	,, ,,	e	14 46 58·68	−26 14 40·1	,, ,,
ζ	14 4 49·43	− 2 6 44·6	,, ,,	i	14 50 7·71	−28 40 30·8	,, ,,
θ	14 8 9·46	− 5 23 35·9	,, ,,	f	14 49 50·96	−27 19 12·0	,, ,,
ι	14 15 11·27	− 9 49 28·9	,, ,,	g	14 50 25·26	−27 34 30·8	,, ,,
κ λ	14 21 18·25	−12 49 23·7	,, ,,	h	14 51 14·20	−27 58 38·2	Four obs., Cape, 1882.
μ	14 27 29·14	−16 7 41·5	,, ,,	n	14 52 36·72	−29 56 31·1	Three obs., Cape, 1882.
ξ	14 34 43·71	−19 24 57·7	,, ,,	o	14 52 43·27	−29 52 55·7	,, ,,
υ	14 35 9·26	−18 9 32·1	,, ,,	l	14 54 0·87	−29 9 18·4	,, ,,
o	14 39 26·02	−20 40 12·3	,, ,,	m	14 57 17·98	−29 29 47·8	,, ,,

Digitized by Google

COMET, 1882 I. (WELLS).

7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δα	Comet—Star. Δδ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Star's Red. to App. Place.	Comp. Star.
1882.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
June 17	5 46 14·4		+6 20·0	0–2	F			+15 36 26·5	0·7379$_n$	+1·21 − 7·7	1
	5 47 25·4	+4 13·05		10–0	F	6 59 47·09	9·6729			+1·21 − 7·7	1
	6 2 50·8	−4 37·96		1–0	F	6 59 55·74	9·6839			+1·22 − 8·0	3
	6 11 3·5		−0 30·7	0–1	F			+15 36 22·6	0·7233$_n$	+1·22 − 7·9	2
	6 14 35·7		+5 2·1	0–1	F			+15 36 26·9	0·7184$_n$	+1·22 − 8·0	3
18	5 51 10·3	+0 24·86		23–0	F	7 13 49·69	9·6674			+1·24 − 8·3	4
	6 1 43·2		+2 21·7	0–16	F			+15 23 48·2	0·7358$_n$	+1·24 − 8·3	4
19	6 6 42·2		+5 35·4	0–8	F			+15 10 53·0	0·7444$_n$	+1·26 − 8·8	5
	6 6 56 4	+0 23·51		10–0	F	7 27 31·32	9·6718			+1·26 − 8·8	5
20	6 16 19·2		−1 38·8	0–6	F			+14 57 31·9	0·7374$_n$	+1·29 − 9·2	6
	6 23 47·4	−2 35·69		20–0	F	7 40 44·06	9·6770			+1·29 − 9·2	6
21	6 17 33·1		+2 38·3	0–5	F			+14 43 36·0	0·7416$_n$	+1·31 − 9·6	7
	6 20 32·5	−1 25·08		14–0	F	7 53 17·61	9·6674			+1·31 − 9·6	7
23	6 10 38·7	+0 37·75		12–0	F	8 16 57·61	9·6421			+1·35 −10·2	8
	6 30 6·0		+3 26·2	0–6	F			+14 13 48·3	0·7423$_n$	+1·35 −10·2	8
24	6 2 57·1	−0 58·91		28–0	F	8 28 3·54	9·6242			+1·38 −10·5	9
	6 4 20·0		+1 22·5	0–10	F			+13 58 20·5	0·7588$_n$	+1·38 −10·5	9
25	6 13 26·4		+0 24·6	0–12	F			+13 41 59·0	0·7567$_n$	+1·41 −10·8	10
	6 18 22·3	−0 38·61		32–0	F	8 38 51·40	9·6341			+1·41 −10·8	10
26	6 9 27·2	−0 5·65		4–0	F	8 49 0·20	9·6145			+1·43 −11·0	11
	6 15 15·7		−0 43·4	0–4	F			+13 25 20·5	0·7579$_n$	+1·43 −11·0	11
	6 30 0·7		−0 14·3	0–4	F			+13 25 7·4	0·7507$_n$	+1·44 −11·1	12
	6 30 48·1	−3 20·47		25–0	F	8 49 8·94	9·6404			+1·44 −11·1	12
29	6 31 25·4		+6 35·8	0–6	F			+12 33 54·9	0·7546$_n$	+1·49 −11·5	13
	6 33 41·1	+2 32·86		30–0	F	9 17 6·55	9·6235			+1·49 −11·5	13
30	6 18 24·0	+0 46·59		24–0	F	9 25 29·71	9·5962			+1·52 −11·6	14
	6 23 0·1		−5 37·1	0–4	F			+12 16 46·8	0·7589$_n$	+1·52 −11·6	14
	6 33 43·3	−0 42·14		28–0	F	9 25 34·70	9·6174			+1·52 −11·7	15
	6 41 50·0		+1 25·6	0–10	F			+12 16 33·7	0·7509$_n$	+1·52 −11·7	15
July 1	6 18 30·9	−1 15·62		32–0	F	9 33 34·73	9·5896			+1·55 −11·8	16
	6 24 35·0		−6 9·6	0–6	F			+11 59 35·0	0·7586$_n$	+1·55 −11·8	16
2	6 38 43·1	−2 8·60		4–0	F	9 41 23·82	9·6117			+1·57 −11·9	17
	6 46 3·0		+3 0·0	0–3	F			+11 42 15·9	0·7505$_n$	+1·57 −11·9	17
8	6 54 28·2	−1 49·49		28–0	F	10 20 54·31	9·6102			+1·68 −12·3	18
	6 55 54·4		−5 26·8	0–8	F			+10 4 26·9	0·7457$_n$	+1·68 −12·3	18
9	6 37 55·4		+5 17·5	0–10	F			+ 9 49 17·0	0·7509$_n$	+1·69 −12·2	19
	6 38 13·0	−0 10·59		31–0	F	10 26 26·97	9·5841			+1·69 −12·2	19
10	6 43 42·7	−2 24·92		20–0	F	10 31 50·50	9·5903			+1·72 −12·3	20
	6 43 52·2		+3 16·0	0–4	F			+ 9 34 16·2	0·7485	+1·72 −12·3	20
11	6 37 11·7		+2 8·9	0–12	F			+ 9 19 42·1	0·7499	+1·72 −12·3	21
	6 37 34·2	+0 18·28		20–0	F	10 36 58·61	9·5782			+1·72 −12·3	21
12	6 43 58·9		−3 31·7	0–4	F			+ 9 5 13·5	0·7464$_n$	+1·73 −12·3	22
	6 44 55·2	+1 19·19		12–0	F	10 41 56·69	9·5877			+1·73 −12·3	22
	7 5 3·6	+0 12·04		10–0	F	10 42 0·81	9·6158			+1·73 −12·4	23
	7 9 0·5		+6 20·3	0–6	F			+ 9 4 55·9	0·7387$_n$	+1·73 −12·4	23
13	6 32 43·5		+0 59·5	0–10	F			+ 8 51 9·1	0·7490$_n$	+1·74 −12·3	24
	6 33 9·7	+0 22·15		20–0	F	10 46 39·60	9·5673			+1·74 −12·3	24

Digitized by Google

COMET, 1882 I.—*continued.*

7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Star's Red. to App. Place.	Comp. Star.
1882.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 14	6 59 34·0		−2 13·0	0–8	F			+ 8 41 57·0	0·7400$_n$	+1·75 −12·3	25
	7 0 53·2	−0 3·63		11–0	F	10 50 28·68	9·6079			+1·75 −12·3	25
15	6 46 45·0		−3 28·3	0–6	F			+ 8 23 41·7	0·7429$_n$	+1·78 −12·3	26
	6 49 46·2	−2 43·37		15–0	F	10 55 40·69	9·5914			+1·78 −12·3	26
19	7 14 6·3	+0 16·72		5–0	F	11 11 49·21	9·6223			+1·81 −12·2	27
	7 16 19·9		−5 5·2	0–6	F			+ 7 32 19·8	0·7302$_n$	+1·81 −12·2	27
20	7 10 57·9		+3 30·0	0–8	F			+ 7 20 11·0	0·7307$_n$	+1·82 −12.2	28
	7 11 11·5	+0 4·91		10–0	F	11 15 29·73	9·6190			+1·82 −12·2	28
21	6 55 36·2		−0 32·7	0–8	F			+ 7 8 26·1	0·7338$_n$	+1·83 −12·1	29
	6 55 58·6	−0 44·39		15–0	F	11 19 1·15	9·5994			+1·83 −12·1	29
22	6 37 30·8	−0 14·94		5–0	F	11 22 25·83	9·5720			+1·84 −12·1	30
	6 43 55·7		+0·47·3	0–2	F			+ 6 56 55·1	0·7355$_n$	+1·84 −12·1	30
23	7 10 7·6		+0 25·8	0–4	F			+ 6 45 9·3	0·7278$_n$	+1·84 −12·1	31
	7 10 11·0	+2 40·75		10–0	F	11 25 50·94	9·6191			+1·84 −12·1	31
24	7 22 41·4	+1 4·93		20–0	F	11 29 7·42	9·6339			+1·85 −12·0	32
	7 26 14·0		−0 39·8	0–6	F			+ 6 33 53·0	0·7225$_n$	+1·85 −12·0	32
26	7 12 36·3	−1 6·59		15–0	F	11 35 18·69	9·6243			+1·87 −11·9	33
	7 12 54·6		+2 44·4	0–8	F			+ 6 12 9·1	0·7240$_n$	+1·87 −11·9	33
27	7 19 4·3		−3 44·8	0–4	F			+ 6 1 25·5	0·7213$_n$	+1·87 −11·9	34
	7 23 27·0	+0 1·65		6–0	F	11 38 18·84	9·6370			+1·87 −11·9	34
Aug. 1	6 50 35·5	−0 17·65		20–0	F	11 52 1·04	9·6047			+1·89 −11·6	35
	6 50 51·9		−2 8·7	0–8	F			+ 5 11 28·4	0·7221$_n$	+1·89 −11·6	35
2	7 35 22·7	+2 9·63		20–0	F	11 54 39·16	9·6552			+1·89 −11·6	36
	7 36 19·9		+1 50·0	0–8	F			+ 5 1 34·9	0·7102$_n$	+1·89 −11·6	36
3	6 56 50·3		−0 1·7	0–4	F			+ 4 55 40·3	0·7185$_n$	+1·90 −11·5	37
	7 5 24·6	+0 40·89		16–0	F	11 56 55·16	9·6277			+1·90 −11·5	37
4	6 39 43·1	−0 10·60		16–0	F	11 59 33·08	9·5987			+1·91 −11·4	38
	6 40 41·2		−1 45·6	0–8	F			+ 4 43 10·3	0·7205$_n$	+1·91 −11·4	38
8	6 56 17·1	+2 17·75		15–0	F	12 8 47·92	9·6244			+1·91 −11·3	39
	6 58 49·3		+4 8·8	0–8	F			+ 4 7 34·4	0·7132$_n$	+1·91 −11·3	39
11	7 29 25·1		−0 55·6	0–4	F			+ 3 41 54·1	0·7059$_n$	+1·92 −11·1	40
	7 42 48·2	+1 6·46		12–0	F	12 15 21·60	9·6704			+1·92 −11·1	40
12	7 12 17·5	−0 7·26		0–8	F	12 17 23·46	9·6477			+1·92 −11·0	41
	7 12 31·0		+3 30·9	0–8	F			+ 3 33 48·4	0·7073$_n$	+1·92 −11·0	41
14	6 26 25·3		−1 46·6	0–4	F			+ 3 17 35·5	0·7079$_n$	+1·93 −10·9	42
	7 8 24·8	+0 28·00		13–0	F	12 21 27·28	9·6475			+1·93 −10·9	42
16	7 1 45·1		−1 51·2	0–4	F			+ 3 1 58·7	0·7054$_n$	+1·94 −10·7	43
	7 18 29·3	−1 29·96		20–0	F	12 25 23·80	9·6597			+1·94 −10·7	43

Notes.

June 26. The C.M. time of the first Δ α may be 1^m wrong. Position angle of tail = 27°.
July 14. Comet faint through cloud.
24. From 7^h 15^m to 7^h 18^m C.M. time the comet was passing a star of about 10·5 mag. For some time it was almost impossible to separate them, but the comet seemed to pass to the south of the star.
Aug. 8, 14. Comet extremely faint.

Digitized by Google

COMET, 1882 I. (WELLS).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1882·0.			Dec. 1882·0.			Authority.
	h	m	s	°	′	″	
1	6	55	32·83	+15	30	14·2	Arg. + 15·1431. Two obs., Cape, 1885.
2	7	2	21·58	+15	37	1·3	Arg. + 15·1482. Two obs., Cape, 1885.
3	7	4	32·48	+15	31	32·7	Arg. +15·1494. Two obs., Cape, 1885.
4	7	13	23·59	+15	21	34·7	Arg. +15·1541. Two obs., Cape, 1885.
5	7	27	6·55	+15	5	26·4	Arg. +15·1601. Two obs., Cape, 1885.
6	7	43	18·46	+14	59	20·0	Arg. +15·1673. Two obs., Cape, 1885.
7	7	54	41·38	+14	41	7·3	Arg. +14·1806. Three obs., Cape, 1885.
8	8	16	18·51	+14	10	32·3	Arg. +14·1882. Two obs., Cape, 1885.
9	8	27	3·25	+13	57	8·5	Arg. +14·1917. Two obs., Cape, 1885.
10	8	39	28·60	+13	41	45·2	Arg. +13·1981. Two obs., Cape, 1885.
11	8	49	4·42	+13	26	14·9	10½ mag. Two obs., Cape, 1885.
12	8	52	27·97	+13	25	32·7	Arg. +13·2019. Two obs., Cape, 1885.
13	9	14	32·20	+12	27	30·7	Arg. +12·2021. Two obs., Cape, 1885.
14	9	24	41·60	+12	22	35·5	Arg. +12·2049. Two obs., Cape, 1885.
15	9	26	15·32	+12	15	19·8	Arg. +12·2053. Two obs., Cape, 1885.
16	9	34	48·80	+12	5	56·4	Arg. +12·2076. Two obs., Cape, 1885.
17	9	43	30·85	+11	39	27·9	Arg. +11·2108. Two obs., Cape, 1885.
18	10	22	42·12	+10	10	6·0	Arg. +10·2157. One obs., Cape, 1885.
19	10	26	35·87	+ 9	54	46·7	ρ Leonis. Nautical Almanac.
20	10	34	13·70	+ 9	31	12·6	Arg. +9·2384. Two obs., Cape, 1885.
21	10	36	38·61	+ 9	17	45·5	Arg. +9·2395. One obs., Cape, 1885.
22	10	40	35·77	+ 9	8	57·5	10 mag. Two obs., Cape, 1885.
23	10	41	47·04	+ 8	58	47·9	Arg. +9·2409. Two obs., Cape, 1885.
24	10	46	15·71	+ 8	50	21·9	Arg. +8·2423. One obs., Cape, 1885.
25	10	50	30·56	+ 8	44	22·3	Arg. +8·2436. One obs., Cape, 1885.
26	10	58	22·28	+ 8	27	22·3	Arg. +8·2454. One obs., Cape, 1885.
27	11	11	30·68	+ 7	37	37·2	Arg. +7·2434. Two obs., Cape, 1885.
28	11	15	23·00	+ 7	16	53·2	Arg. +7·2440. Two obs., Cape, 1885.
29	11	19	43·71	+ 7	9	10·9	10 mag. Two obs., Cape, 1885.
30	11	22	38·93	+ 6	56	19·9	Arg. +7·2451. One obs., Cape, 1885.
31	11	23	8·35	+ 6	44	55·6	Three obs., Cape, 1890.
32	11	28	0·64	+ 6	34	44·8	Arg. +6·2465. One obs., Cape, 1885.
33	11	36	23·41	+ 6	9	36·5	Arg. +6·2485. Two obs., Cape, 1885.
34	11	38	15·32	+ 6	5	22·2	Arg. +6·2490. Two obs., Cape, 1885.
35	11	52	16·80	+ 5	13	48·8	Arg. +5·2562. Two obs., Cape, 1885.
36	11	52	27·64	+ 4	59	56·5	Arg. +5·2563. One obs., Cape, 1885.
37	11	56	12·37	+ 4	55	53·5	Arg. +5·2573. Two obs., Cape, 1885.
38	11	59	41·77	+ 4	45	7·4	Arg. +4.2572. Two obs., Cape, 1885.
39	12	6	28·26	+ 4	3	36·9	Arg. +4·2585. One obs., Cape, 1885.
40	12	14	13·22	+ 3	43	0·8	Arg. +3·2632. One obs., Cape, 1885.
41	12	17	28·80	+ 3	30	28·5	Arg. +3·2638. Two obs., Cape, 1885.
42	12	20	57·35	+ 3	19	33·0	Arg. +3·2645. One obs., Cape, 1885.
43	12	26	51·82	+ 3	4	0·6	Arg. +3·2663. Two obs., Cape, 1885.

Digitized by Google

COMET, 1884 I. (PONS-BROOKS).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1884.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Jan. 16	8 38 38·2	−2 3·65		4–0	F	23 23 28·29	9·6755			−0·08 + 0·8	1
	8 47 0·6		+5 55·6	0–3	F			− 4 37 20·3	0·6775$_n$	−0·08 + 0·8	1
24	8 37 2·2	−4 12·19	+2 17·5	1–1	F	0 3 6·92	9·6897	−17 47 36·4	0·6002$_n$	−0·12 − 4·9	2
	8 45 13·2		+5 34·6	0–4	F			−17 48 2·8	0·5950$_n$	−0·14 − 4·7	3
	8 53 42·2	−0 52·31		8–0	F	0 3 9·96	9·6984			−0·14 − 4·7	3
26	8 44 29·2	−3 27·81	−2 50·0	8–8	F	0 11 32·46	9·7189	−20 37 20·5	0·6572$_n$	−0·15 − 6·0	4
28	9 7 36·1	+3 25·46	+1 0·2	6–7	F	0 19 25·31	9·7198	−23 16 11·1	0·6005$_n$	−0·21 − 6·7	5
29	8 44 31·2	−1 30·04	−3 37·2	8–8	F	0 23 4·33	9·7136	−24 29 29·9	0·5589$_n$	−0·21 − 7·4	6
Feb. 2	8 37 5·3	−0 25·57	−3 12·9	3–3	F	0 36 40·74	9·7331	−29 0 57·6	0·5266$_n$	−0·29 − 8·9	7
	8 46 21·4	−6 18·13	+6 26·9	2–2	F	0 36 42·45	9·7372	−29 1 20·1	0·5433$_n$	−0·26 − 9·3	8
4	8 25 35·6	+1 24·83	−2 0·1	8–8	F	0 42 47·56	9·7296	−31 1 38·6	0·4620$_n$	−0·34 − 9·5	9
6	8 23 16·6	+0 4·11	+3 58·1	20–20	F	0 48 32·92	9·7391	−32 54 4·8	0·4408$_n$	−0·38 −10·1	10
7	8 33 44·0	−2 39·04	−3 42·3	8–8	F	0 51 17·98	9·7512	−33 47 42·6	0·4603$_n$	−0·38 −10·5	11
9	8 51 35·7	+0 3·21		12–0	F	0 56 34·50	9·7702			−0·42 −11·1	12
	9 3 28·4		−8 1·6	0–10	F			−35 29 26·7	0·5244$_n$	−0·42 −11·1	12
10	8 36 49·0	−1 56·86	+0 54·5	12–12	F	0 59 2·90	9·7681	−36 16 9·5	0·4495$_n$	−0·46 −11·2	13
12	8 50 55·2	−0 36·28	−0 24·5	10–10	F	1 3 53·55	9·7844	−37 47 1·4	0·4807$_n$	−0·52 −11·4	14
15	8 25 36·4	+0 52·97	+1 35·2	10–10	F	1 10 39·37	9·7877	−39 51 16·1	0·3923$_n$	−0·59 −12·1	15
17	8 33 35·0	−2 5·19	−2 38·9	6–6	F	1 14 56·85	9·8018	−41 7 43·4	0·4150$_n$	−0·65 −12·1	16
18	8 50 39·8	−1 22·09	+7 48·9	12–12	F	1 17 4·81	9·8127	−41 44 48·4	0·4696$_n$	−0·68 −12·2	17
19	8 35 31·4	−2 43·13	+1 21·5	4–4	F	1 19 7·41	9·8122	−42 19 49·1	0·4189$_n$	−0·70 −12·4	18
22	9 15 5·5	+1 54·24	−6 16·1	6–6	F	1 25 13·13	9·8334	−44 1 14·3	0·5442$_n$	−0·81 −12·2	19
24	7 35 0·1	+0 6·69	−4 50·8	12–12	F	1 29 0·92	9·8001	−45 1 40·0	0·1201$_n$	−0·86 −12·4	20
25	8 0 54·0	−0 46·35	−8 16·4	12–12	F	1 30 59·92	9·8243	−45 32 20·5	0·2708$_n$	−0·89 −12·5	21
26	8 22 21·8	−2 11·65	−2 29·6	10–10	F	1 32 58·16	9·8397	−46 2 10·2	0·3707$_n$	−0·91 −12·6	22
27	8 10 44·3	−1 51·73	+5 12·1	10–10	F	1 34 53·61	9·8394	−46 30 39·3	0·3198$_n$	−0·97 −12·3	23
29	8 28 5·4	−2 41·55	+5 10·3	10–10	F	1 38 48·25	9·8547	−47 26 36·7	0·3937$_n$	−1·01 − 12·7	24
March 2	8 19 4·1	−2 58·67	+3 59·7	12–12	F	1 42 40·76	9·8610	−48 19 50·1	0·3654$_n$	−1·07 −12·7	25
3	7 55 18·1	+0 46·75	−0 53·9	6–6	F	1 44 36·51	9·8557	−48 45 24·3	0·2527$_n$	−1·13 −12·2	26
4	7 59 36·2	+1 10·03	+0 50·6	12–12	F	1 46 35·40	9·8621	−49 10 55·8	0·2746$_n$	−1·15 −12·5	27
7	8 18 23·9	−0 56·93	−0 50·2	20–20	F	1 52 36·82	9·8821	−50 25 19·3	0·3758$_n$	−1·26 −12·3	28
8	8 19 52·3	−0 8·11		10–0	F	1 54 38·61	9·8867			−1·28 −12·3	29
	8 29 22·2		−6 58·0	0–10	F			−50 49 30·8	0·4263$_n$	−1·28 −12·3	29
9	8 48 15·8	+1 20·05	−5 28·1	8–8	F	1 56 45·09	9·8934	−51 13 24·4	0·4774$_n$	−1·32 −12·2	30
14	8 12 27·7	−1 6·38	−5 4·3	6–6	F	2 7 25·47	9·9095	−53 7 3·7	0·3682$_n$	−1·49 −12·2	31
16	8 13 14·2	−3 18·81	−7 12·1	6–6	F	2 11 56·09	9·9179	−53 51 13·0	0·3790$_n$	−1·54 −12·5	32
21	8 3 22·7	+2 30·54	+3 42·6	10–10	F	2 23 57·69	9·9367	−55 38 45·7	0·3404$_n$	−1·78 −11·7	33
22	8 19 13·5	+1 9·00	−2 24·4	10–10	F	2 26 33·24	9·9541	−56 0 15·3	0·4068$_n$	−1·80 −11·8	34
24	8 7 28·5	+0 32·02	+3 44·4	12–12	F	2 31 47·55	9·9498	−56 42 5·7	0·3659$_n$	−1·90 −11·8	35

Digitized by Google

COMET, 1884 I. (PONS-BROOKS)—*continued.*

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1884.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
March 27	7 52 50·0	−1 12·45	−4 29·8	16–16	P	2 40 6·57	9·9600	−57 44 31·7	0·2830$_n$	−1·99 −12·1	36
28	7 46 47·7	−1 59·46	+3 57·4	12–12	F	2 43 0·63	9·9630	−58 5 0·5	0·2445$_n$	−2·04 −12·2	37
April 1	7 42 25·8	+0 43·08	−4 50·3	8–8	F	2 55 20·93	9·9802	−59 27 12·3	0·2171$_n$	−2·21 −12·1	38
13	7 30 18·0	−0 49·55	+6 46·9	13–8	F	3 40 37·27	0·0309	−63 26 15·6	9·9593$_n$	−2·74 −14·1	39
14	7 25 31·0	+1 12·20	+3 35·1	8–8	F	3 45 2·66	0·0357	−63 45 18·4	9·9307$_n$	−2·84 −13·4	40
21	7 35 19·4	−1 58·03	+8 21·2	12–12	P	4 19 53·79	0·0703	−65 51 52·2	9·8504$_n$	−3·08 −16·0	41
22	7 41 44·1	+0 38·77	−4 14·3	16–16	P	4 25 25·40	0·0767	−66 8 46·8	9·9149$_n$	−3·10 −16·0	42
23	7 40 13·3	+1 34·79	−3 10·1	12–12	P	4 31 6·00	0·0804	−66 25 4·8	9·8502$_n$	−3·13 −16·3	43
26	7 30 5·4		−1 13·1	0–12	F			−67 11 23·7	9·2563$_n$	−3·17 −17·6	44
	7 35 26·8	−0 28·28		15–0	F	4 48 54·50	0·0895			−3·17 −17·6	44
29	7 48 59·6		+7 33·4	0–6	F			−67 53 15·4	9·6370$_n$	−3·22 −19·1	45
	8 6 27·5	−1 50·15		10–0	F	5 8 12·54	0·1105			−3·22 −19·1	45

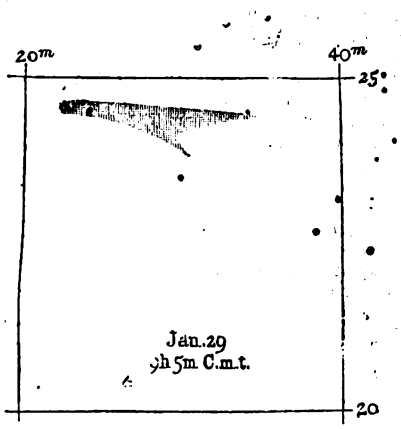
Notes.

Jan. 16. Head very bright.
24. Tail faint and less than 2° in length; quite straight.
28. Observations interfered with by clouds.
29. No trace of a stellar nucleus could be seen.

Feb.. 4. Stellar nucleus, surrounded by coma almost as bright.
6. Head much more diffused.
9. Poor definition. Comet's head very diffused; it takes about 1ˢ to transit the wire.
15. Tail very faint. At 8ʰ 15ᵐ mean time I can trace it in the finder to the bright star following and about half as far again. It is narrow and straight; the bright star is just inside its southern edge.
25. A very faint tail visible in the finder; position angle approximately 134°.
26. Position angle of tail = 114°. Traces of another very faint tail could just be seen at position angle 153°± (*see* figure).
29. Definition poor, looking through vapour on the mountain. Comet a difficult object to bisect.

Mar. 2. Occasional glimpses of a star-like nucleus: the point observed was in following part of head (where the nucleus was seen).
21 Head bright, but ill-defined, surrounded by nebulous mass. Still faint trace of very short tail.

Apr. 13. An 11th magnitude star near the comet very troublesome. The comet was almost centrally over this star earlier in the evening, and the star then was brighter than when the comet had passed away from it. The moonlight was, however, increasing rapidly towards the end of the measures.
21. Exceedingly faint.



Feb.25

Feb.26

Digitized by Google

COMET, 1884 I. (PONS-BROOKS).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1884·0.			Dec. 1884·0.			Authority.
	h	m	s	°	′	″	
1	23	25	32·02	− 4	43	16·7	Lal. 46057. Three Cape Obs., 1884.
2	0	7	19·23	−17	49	49·0	Three Cape Obs., 1884.
3	0	4	2·41	−17	53	32·7	Bulletin Astr., IV., March.
4	0	15	0·42	−20	34	24·5	Two Cape Obs., 1884.
5	0	16	0·06	−23	17	3·9	Oeltz. Arg., and Cordoba Zones, $0^h·408$.
6	0	24	34·58	−24	25	45·4	Stone, 179, Cordoba Zones, $0^h·639$.
7	0	37	6·60	−28	57	35·8	Two Cape Obs., 1884.
8	0	43	0·84	−29	7	37·7	Stone, 319.
9	0	41	23·07	−30	59	29·0	Two Cape Obs., 1884.
10	0	48	29·19	−32	57	52·8	Stone, 353.
11	0	53	57·40	−33	43	49·8	Three Cape Obs., 1884.
12	0	56	31·71	−35	21	14·0	10 mag. Equat. diff. from *a*.
a	1	0	50·87	−35	25	8·9	Stone, 429.
13	1	1	0·22	−36	16	52·9	Stone, 431.
14	1	4	30·35	−37	46	25·5	$10\frac{1}{2}$ mag. Three Cape Obs., 1884.
15	1	9	46·99	−39	52	39·2	$10\frac{1}{2}$ mag. Equat. diff. from *b*.
b	1	14	19·00	−39	58	27·3	Two obs., Cape, 1884.
16	1	17	2·69	−41	4	52·4	Two obs., Cape, 1884, and Cordoba Zones.
17	1	18	27·58	−41	52	25·1	Stone, 545.
18	1	21	51·24	−42	20	58·2	Stone, 568.
19	1	23	19·70	−43	54	46·0	Stone, 580.
20	1	28	55·09	−44	56	36·8	Cordoba Zones, $1^h·755$.
21	1	31	47·16	−45	23	51·7	Cordoba Zones, $1^h·833$.
22	1	35	10·72	−45	59	28·0	Two Cape Obs., 1884.
c	1	33	12·50	−46	40	30·1	Stone, 646.
23	1	36	46·31	−46	35	39·1	8 mag. Equat. diff. from *c*.
24	1	41	30·81	−47	31	34·3	One obs., Cape, 1884, and Cordoba Zones, $1^h·1055$.
25	1	45	40·50	−48	23	37·1	Stone, 732.
d	1	42	41·90	−48	48	13·5	One obs., Cape, 1884, and Cordoba Zones, $1^h·1086$.
26	1	43	50·89	−48	44	18·2	$9\frac{1}{2}$ mag. Equat. diff. from *d*.
27	1	47	46·58	−49	11	33·9	One obs., Cape, 1884, and Cordoba Zones, $1^h·1233$.
28	1	51	41·15	−50	24	16·8	Stone, 769. Cordoba Zones, $1^h·1331$.
29	1	54	48·00	−50	42	20·5	Two Cape Obs., 1884. Cordoba Zones, $1^h·1437$.
30	1	55	26·36	−51	7	44·2	Cordoba Zones, $1^h·1466$.
31	2	8	33·34	−53	1	47·2	Two Cape Obs., 1884.
32	2	15	16·44	−53	43	48·4	One Cape Obs., 1884. Cordoba Zones, $2^h·394$.
33	2	21	28·93	−55	42	16·6	Two Cape Obs., 1884.
e	2	24	38·24	−55	54	4·8	One Cape Obs., 1884. Cordoba Zones, $2^h·651$.
34	2	25	26·04	−55	57	39·1	10 mag. Equat. diff. from *e*.
f	2	29	43·19	−56	49	40·6	Two Cape Obs., 1884.
35	2	31	17·43	−56	45	38·4	10 mag. Equat. diff. from *f*.
36	2	41	21·01	−57	39	49·8	Two Cape Obs., 1884.
37	2	45	2·13	−58	8	45·7	Gould's Gen. Cat., 3026.
38	2	54	40·06	−59	22	9·9	One Cape Obs., 1884. Cordoba Zones, $2^h·1483$.
39	3	41	29·56	−63	32	48·4	$9\frac{1}{2}$ mag. Equat. diff. from *g*.
g	3	44	36·47	−63	31	19·6	One Cape Obs., 1884. Cordoba Zones, $3^h·1243$.
h	3	41	28·20	−63	48	49·9	Gould's Gen. Cat., 4183.
40	3	43	53·30	−63	48	40·1	$10\frac{1}{2}$ mag. Equat. diff. from *h*.
41	4	21	54·90	−65	59	57·4	Gould's Gen. Cat., 4987.
42	4	24	49·73	−66	4	16·5	One Cape Obs., 1884. Cordoba Zones, $4^h·823$.
43	4	29	34·34	−66	21	38·4	Two Cape Obs., 1884 and 1885.
i	4	49	15·70	−67	1	36·8	Two Cape Obs., 1884.
44	4	49	25·95	−67	9	53·0	$10\frac{1}{2}$ mag. Equat. diff. from *i*.
45	5	10	5·91	−68	0	29·7	Two Cape Obs., 1884.

Digitized by Google

COMET, 1884 II. (BARNARD).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1884.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 24	10 8 8·1	−0 13·07	−6 56·1	4-4	F	16 5 30·42	9·5326	−37 14 49·4	9·5267$_n$	+3·83 − 5·5	1
26	10 38 4·0	+4 30·38	+6 29·0	4-4	F	16 10 14·69	9·6144	−37 15 34·5	9·7858$_n$	+3·82 − 5·6	2
27	10 54 54·1	+0 10·09	+1 14·3	16-16	F	16 12 41·63	9·6502	−37 15 35·0	9·9337$_n$	+3·84 − 5·0	3
28	11 6 15·8	−0 14·11	−6 33·3	16-16	F	16 15 14·61	9·6720	−37 15 30·4	0·0188$_n$	+3·84 − 4·7	4
29	11 10 32·2	+1 0·99	+2 26·8	16-16	F	16 17 52·45	9·6809	−37 15 15·1	0·0541$_n$	+3·82 − 4·6	5
30	11 5 15·7	+0 47·41	−1 59·5	16-16	F	16 20 33·87	9·6736	−37 14 46·8	0·0261$_n$	+3·84 − 4·3	6
Aug. 1	10 19 53·3	−0 7·04	−1 31·0	10-6	F	16 26 5·59	9·5904	−37 13 19·7	9·5380$_n$	+3·84 − 3·8	7
5	9 35 49·5	+0 32·05	−0 53·5	16-16	F	16 38 8·32	9·4771	−37 7 6·3	8·6459$_n$	+3·83 − 3·0	8
6	9 53 49·7	+0 30·06	−2 18·8	16-16	F	16 41 24·22	9·5267	−37 4 44·8	9·3941$_n$	+3·84 − 2·5	9
7	10 10 18·4	+0 21·60	−1 31·6	16-16	F	16 44 43·71	9·5794	−37 2 3·4	9·6545$_n$	+3·84 − 2·1	10
8	10 10 5·0	−0 20·07	+0 46·7	20-16	F	16 48 4·68	9·5794	−36 59 10·3	9·6545$_n$	+3·85 − 1·8	11
11	10 4 50·6	−0 22·80	+1 2·6	20-15	F	16 58 29·41	9·5691	−36 48 6·1	9·6371$_n$	+3·85 − 0·8	12
13	10 14 35·2	+0 23·13	+3 30·7	20-16	F	17 5 45·47	9.5933	−36 38 45·1	9·7664$_n$	+3·85 − 0·2	13
14	9 48 55·4	−0 21·98	+3 17·2	12-12	F	17 9 23·77	9·5267	−36 33 26·1	9·4784$_n$	+3·85 + 0·2	14
17	9 47 36·8	+0 29·46	−0 0·8	16-16	F	17 20 47·51	9·5232	−36 14 55·3	9·5267$_n$	+3·84 + 1·2	15
19	10 10 4·8	−0 17·79	+2 37·2	15-16	F	17 28 40·78	9·5714	−36 0 5·5	9·7794$_n$	+3·84 + 2·1	16
20	10 2 33·1		+0 9·5	0-8	F			−35 52 14·6	9·7178$_n$	+3·83 + 2·4	17
	10 12 46·7	−0 25·17		16-00	F	17 32 39·90	9·5864			+3·83 + 2·4	17
22	10 26 1·8	+0 10·08	−4 52·3	16-16	F	17 40 44·38	9·6134	−35 34 25·5	9·9469$_n$	+3·82 + 3·2	18
23	10 4 39·6	+0 35·86	−5 3·8	16-16	F	17 44 44·89	9·5639	−35 24 55·1	9·7982$_n$	+3·81 + 3·5	19
Sept. 15	10 19 31·8	+0 11·50	−5 7·9	24-18	F	19 20 3·94	9·5607	−29 37 6·1	0·1824$_n$	+3·59 +12·2	20
17	10 27 13·5	−0 51·09	−2 12·9	16-16	F	19 28 0·70	9·5732	−28 57 17·9	0·2187$_n$	+3·57 +13·0	21
21	9 44 44·1	−0 16·70	+2 26·6	17-12	F	19 43 24·52	9·4601	−27 35 48·0	0·1722$_n$	+3·52 +14·2	22
22	10 12 12·9	+0 54·93	−0 7·3	12-16	F	19 47 16·43	9·5335	−27 14 19·6	0·2414$_n$	+3·50 +14·4	23
Oct. 14	9 53 42·7	−0 6·41	−4 38·1	32-16	F	21 2 13·61	9·4922	−19 15 58·8	0·4312$_n$	+3·25 +19·6	24
15	9 45 49·0	−0 4·28	+2 33·9	24-16	F	21 5 14·49	9·4732	−18 54 32·6	0·4312$_n$	+3·24 +19·7	25
16	11 1 50·6	−0 17·32	+2 37·0	16-12	F	21 8 23·66	9·6227	−18 32 3·1	0·5169$_n$	+3·23 +19·9	26
17	9 56 51·5	+0 35·86	−3 42·1	24-16	F	21 11 14·38	9·5032	−18 11 38·8	0·4575$_n$	+3·22 +20·0	27
20	10 33 4·0	−0 1·70	+1 31·2	16-8	F	21 20 2·96	9·5650	−17 7 49·0	0·5029$_n$	+3·20 +20·5	28
24	10 26 26·6	−0 30·77	−0 49·1	6-14	F	21 31 21·43	9·5743	−15 44 56·8	0·5335$_n$	+3·17 +21·0	29

Notes.

July 24. Comet exceedingly faint and difficult: hazy.
28. Comet much easier to-night: distinct appearance of nucleus or condensation.
Aug. 1. Comet very faint: bright moonlight.
5. Moon very bright, but fair observations.
7. Bright moonlight: air very damp and hazy: comet very faint.
19. Comet very faint: very difficult.
20. Comet exceedingly faint: scarcely possible to observe it at all.
22. Fair observations.
Sept. 15. Comet much easier to observe, and brighter than in August.
Oct. 15. Comet faint; difficult in R.A.
16. Comet *very* faint.
20, 24. Comet excessively faint.

Digitized by Google

COMET, 1884 II.—(BARNARD).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1884·0.			Dec. 1884·0.			Authority.
	h	m	s	°	′	″	
a	16	3	34·56	−37	9	18·6	Three Cape obs., 1884.
1	16	5	39·66	−37	7	47·8	9½ mag. Equat. diff. from *a*.
2	16	5	40·49	−37	21	57·9	9 mag. Equat. diff. from 3.
3	16	10	2·46	−37	27	47·8	Three Cape obs., 1884.
b	16	12	27·70	−37	16	44·3	10 mag. Equat. diff. from 4 and 5.
4	16	15	24·88	−37	8	52·4	Stone, 8897.
5	16	16	47·64	−37	17	37·2	Stone, 8913.
6	16	19	42·64	−37	12	42·6	7½ mag. Equat. diff. from 5.
c	16	25	55·69	−37	8	1·8	Two Cape obs., 1884.
7	16	26	8·79	−37	11	44·9	10 mag. Equat. diff. from *c*.
d	16	34	59·59	−37	6	55·4	Stone, 9061.
8	16	37	32·44	−37	6	9·8	10 mag. Equat. diff. from *d*.
9	16	40	50·32	−37	2	23·5	Two Cape obs., 1884.
10	16	44	18·27	−37	0	29·7	9⅓ mag. Equat. diff. from 9 and 11.
11	16	48	20·90	−36	59	55·2	Three Cape obs., 1884.
e	16	58	33·23	−36	56	17·0	Two Cape obs., 1884.
12	16	58	48·36	−36	49	7·9	10 mag. Equat. diff. from *c*.
13	17	5	18·49	−36	42	15·6	Two Cape obs., 1884.
14	17	9	41·90	−36	36	43·5	Three Cape obs., 1884.
15	17	20	14·21	−36	14	55·7	Two Cape obs., 1884.
16	17	28	54·73	−36	2	44·8	10⅓ mag. Equat. diff. from *f*.
f	17	29	21·63	−36	5	18·2	Two Cape obs., 1884.
17	17	33	1·24	−35	52	26·6	Two Cape obs., 1884.
18	17	40	30·48	−35	29	36·4	Two Cape obs., 1884.
19	17	44	5·22	−35	19	54·8	One Cape obs., 1884. (= Yarnall 7433.)
20	19	19	48·85	−29	32	10·4	Two Cape obs., 1884.
21	19	28	48·22	−28	55	18·0	Two Cape obs., 1884.
22	19	43	37·70	−27	38	28·8	Stone, 10,673.
23	19	46	18·00	−27	14	27·4	One Cape obs., 1884. (= O.A. 20,039.)
24	21	2	16·77	−19	11	40·3	Three Cape obs., 1884. (= O.A. 21,151.)
g	21	3	49·83	−18	55	44·6	Two Cape obs., 1884. (= O.A. 21,180.)
25	21	5	15·53	−18	57	26·2	9 mag. Equat. diff. from *g*.
26	21	8	37·75	−18	34	59·9	Four Cape obs., 1884.
27	21	10	35·30	−18	8	16·7	10 mag. Equat. diff. from *h*.
h	21	13	16·31	−18	7	26·8	Three Cape obs., 1884.
28	21	20	1·46	−17	9	40·6	Two Cape obs., 1884.
29	21	31	49·03	−15	44	28·7	9½ mag. Equat. diff. from *i*.
i	21	36	22·20	−15	51	42·1	Two Cape obs., 1884.

Digitized by Google

COMET, 1884 III. (WOLF).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1884.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Oct. 20	8 49 36·7	−0 32·94	−0 38·9	30–16	F	21 47 43·01	9·1215	+8 9 42·7	0·7687$_n$	+3·21 +28·8	1
23	10 45 1·3	+0 51·91	+1 52·0	8–6	F	21 53 8·85	9·5483	+6 45 52·9	0·7403$_n$	+3·19 +28·4	2
24	9 18 12·4	+0 19·88	+0 26·2	14–20	F	21 54 51·30	9·2269	+6 20 54·5	0·7499$_n$	+3·20 +28·2	3
25	9 27 16·9	+0 35·23	+2 24·3	16–20	F	21 56 45·52	9·3532	+5 54 38·1	0·7451$_n$	+3·19 +28·1	4
Nov. 3	8 51 22·4	+0 38·90	+4 55·7	10–8	F	22 14 54·58	9·2733	+2 17 26·5	0·7143$_n$	+3·16 +26·8	5
4	8 57 23·1	−0 31·66	−3 31·9	12–12	F	22 17 4·10	9·3081	+1 55 14·8	0·7103$_n$	+3·16 +26·7	6
6	8 37 38·2		+4 11·6	0–6	F			+1 12 59·7	0·7036$_n$	+3·16 +26·3	7
	8 54 24·9	+0 35·08		14–0	F	22 21 26·77	9·3120			+3·16 +26·3	7
8	8 34 19·1	+0 12·69	+3 8·0	30–20	F	22 25 53·77	9·2345	+0 32 19·7	0·6969$_n$	+3·17 +26·0	8
10	8 37 9·3	+0 46·56	−1 44·2	20–16	F	22 30 27·35	9·2638	−0 6 24·3	0·6902$_n$	+3·16 +25·7	9
12	8 30 10·3	+0 21·98	−2 53·9	20–16	F	22 35 5·04	9·2445	−0 43 1·3	0·6834$_n$	+3·15 +25·4	10
17	8 30 4·2	−1 5·27	+3 15·9	16–12	F	22 46 58·58	9·2824	−2 5 55·6	0·6684$_n$	+3·15 +24·4	11
18	8 35 57·6	+0 51·86	−0 13·7	16–8	F	22 49 24·63	9·3164	−2 21 0·2	0·6657$_n$	+3·16 +24·3	12
25	8 29 30·9	−1 29·69	+2 5·4	10–8	F	23 6 43·41	9·3291	−3 52 18·6	0·6489$_n$	+3·16 +22·9	13
Dec. 9	8 56 6·8	+0 34·17	+6 46·1	20–16	F	23 42 33·07	9·4743	−5 45 54·9	0·6334$_n$	+3·15 +20·2	14
15	8 42 30·5	+0 36·99	−3 17·9	20–16	F	23 58 0·90	9·4619	−6 9 21·1	0·6285$_n$	+3·15 +19·0	15
1885.											
Jan. 7	8 55 24·5	−0 33·58	+1 8·1	8–12	F	0 57 1·97	9·5557	−5 53 0·0	0·6399$_n$	+0·16 − 5·2	16
10	8 49 11·8	+0 43·91	−2 44·3	7–8	F	1 4 34·73	9·5539	−5 41 27·5	0·6423$_n$	+0·15 − 5·6	17
12	9 1 2·7	−0 42·18	+0 52·3	12–12	F	1 9 37·63	9·5785	−5 32 43·0	0·6470$_n$	+0·16 − 6·0	18
14	9 4 2·4	+0 59·92	+3 8·3	16–12	F	1 14 38·04	9·5871	−5 23 21·6	0·6495$_n$	+0·16 − 6·3	19
15	8 53 51·8	−1 21·91	−3 40·9	8–12	F	1 17 6·30	9·5739	−5 18 29·2	0·6484$_n$	+0·18 − 6·4	20
19	8 46 6·2	+0 19·39	+0 3·8	13–12	F	1 27 1·78	9·5696	−4 57 23·1	0·6511$_n$	+0·18 − 6·9	21
20	8 54 30·0	−1 22·77	+1 39·4	12–14	F	1 29 31·54	9·5853	−4 51 47·8	0·6538$_n$	+0·20 − 7·1	22
21	8 51 39·5	+0 35·00	−2 12·7	12–8	F	1 32 0·02	9·5837	−4 46 7·0	0·6545$_n$	+0·18 − 7·2	23
Feb. 12	8 28 59·3	−0 47·51	+3 28·4	16–8	F	2 25 12·46	9·5985	−2 19 22·9	0·6752$_n$	+0·19 − 9·8	24
13	8 34 11·3	+0 43·86	+3 53·2	16–12	F	2 27 35·32	9·6071	−2 12 8·9	0·6765$_n$	+0·20 − 9·8	25
14	8 34 24·2	+0 27·67	+0 0·5	16–12	F	2 29 57·25	9·6091	−2 4 55·8	0·6776$_n$	+0·19 − 9·9	26

Notes.

Nov. 3. Comet very faint; moonlight and haze.
6. Measures frequently interrupted by cloud.
Dec. 9. Nucleus = star of 11th magnitude.
Jan. 10. Comet faint; hazy.
21. Comet very faint; moonlight. A very faint star near the comet was troublesome.

Digitized by Google

COMET, 1884 III. (WOLF).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1884·0.	Dec. 1884·0.	Authority.
	h m s	° ′ ″	
1	21 48 12·74	+ 8 9 52·8	Two obs., Cape, 1884
2	21 52 13·75	+ 6 43 32·5	Equat. comp. with *a*.
a	21 50 43·18	+ 6 41 34·6	Three obs., Cape, 1884 and 1886.
3	21 54 28·22	+ 6 20 0·1	Three obs., Cape, 1884 and 1886.
b	21 54 57·47	+ 5 46 22·2	Two obs., Cape, 1884.
4	21 56 7·10	+ 5 51 45·7	Equat. comp. with *b*.
5	22 14 12·52	+ 2 12 4·0	Two obs., Cape, 1884.
6	22 17 32·60	+ 1 58 20·0	Equat. comp. with *c*.
c	22 18 54·73	+ 2 3 58·0	Three obs., Cape, 1884 and 1886.
7	22 20 48·53	+ 1 8 21·8	Equat. comp. with *d*.
d	22 21 54·31	+ 1 3 58·0	Three obs., Cape, 1884 and 1886.
8	22 25 37·90	+ 0 28 45·7	Equat. comp. with *e*.
e	22 26 45·73	+ 0 30 26·8	Two obs., Cape, 1886.
f	22 28 39·93	− 0 0 3·5	Three obs., Cape, 1884 and 1886.
9	22 29 37·63	− 0 5 5·8	Equat. comp. with *f*.
10	22 34 39·91	− 0 40 32·8	Two obs., Cape, 1886.
11	22 48 0·70	− 2 9 35·9	Two obs., Cape, 1886.
12	22 48 29·61	− 2 21 10·8	Four obs., Cape, 1886.
13	23 8 9·94	− 3 54 46·9	Four obs., Cape, 1886. (*Obs. rather discordant.*)
14	23 41 55·75	− 5 53 1·2	Two obs., Cape, 1886.
15	23 57 20·76	− 6 6 22·2	Two obs., Cape, 1886.
	R.A. 1885·0.	Dec. 1885·0.	
	h m s	° ′ ″	
16	0 57 35·39	− 5 54 2·9	Equat. comp. with
g	0 58 47·87	− 5 56 18·9	Two obs., Cape, 1886.
17	1 3 50·67	− 5 38 37·6	Two obs., Cape, 1886.
18	1 10 19·65	− 5 33 29·3	Two obs., Cape, 1886.
19	1 13 37·96	− 5 26 23·6	Two obs., Cape, 1886.
20	1 18 28·03	− 5 14 41·9	Equat. comp. with *h*.
h	1 20 31·13	− 5 16 9·3	Two obs., Cape, 1886.
21	1 26 42·21	− 4 57 20·0	Equat. comp. with 22.
22	1 30 54·11	− 4 53 20·1	Two obs., Cape, 1886.
23	1 31 24·84	− 4 43 47·1	Two obs., Cape, 1886.
24	2 25 59·78	− 2 22 41·5	Equat. comp. with 25.
25	2 26 51·26	− 2 15 52·3	Three obs., Cape, 1886.
26	2 29 29·39	− 2 4 46·4	Equat. comp. with *i*.
i	2 33 5·62	− 2 4 58·3	Three obs., Cape, 1886.

Digitized by Google

COMET, 1885 III.

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Star's Red. to App. Place.	Comp. Star.
1885.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 12	9 37 59·0	−0 12·35	−3 51·6	30–20	F	17 12 55·81	8·3901$_n$	− 7 31 3·3	0·5922$_n$	+2·94 +8·7	1
13	8 56 5·9	+1 25·55	−6 4·7	20–12	F	17 11 10·39	9·0097$_n$	− 8 4 11·4	0·5860$_n$	+2·94 +8·6	2
	9 42 11·2	−0 47·78	+6 3·1	12–12	F	17 11 6·75	7·4544$_n$	− 8 5 11·9	0·5832$_n$	+2·95 +8·7	3
14	9 40 3·7	+0 8·00	+5 33·7	36–10	F	17 9 20·05	7·5760	− 8 39 11·7	0·5742$_n$	+2·94 +8·2	4
30	7 34 39·8	+1 25·85	−7 59·9	11–8	F	16 45 34·19	8·9125$_n$	−17 6 54·6	0·4081$_n$	+2·92 +5·1	5
Aug. 2	8 16 15·1	+2 7·89	+0 17·3	12–6	F	16 42 8·96	8·7415	−18 34 17·0	0·3673$_n$	+2·90 +4·4	6
3	9 24 3·6	−0 50·62	+0 29·6	24–12	F	16 41 1·14	9·3123	−19 3 42·7	0·3870$_n$	+2·91 +4·4	7

Notes.

July 30. Poor night: hazy sky.
Star 7 seems to have a well-marked proper motion in declination, about −0″·42. It is Oeltz. Arg. 15,974, and was observed at Paris in 1857 and 1870.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1885·0.	Dec. 1885·0.	Authority.
	h m s	° ′ ″	
a	17 11 44·72	− 7 32 11·2	Two obs., Cape, 1885.
1	17 13 5·22	− 7 27 20·4	10 mag. Equat. diff. from *a*.
2	17 9 41·90	− 7 58 15·3	10 mag. Equat. diff. from *b*.
b	17 9 50·18	− 7 54 42·0	Two obs., Cape, 1885. (=Schj. 6158.)
3	17 11 51·58	− 8 11 23·7	Two obs., Cape, 1885. (=Schj. 6166.)
c	17 5 17·81	− 8 40 14·5	Three obs., Cape, 1885.
4	17 9 9·11	− 8 44 53·6	10 mag. Equat. diff. from *c*.
5	16 44 5·42	−16 58 59·8	One obs., Cape, 1885. (=A. Oe. 16,018.)
6	16 39 57·17	−18 34 38·7	Two obs., Cape, 1885.
7	16 41 48·85	−19 4 16·7	Three obs., Cape, 1890, corrected for proper motion.

Digitized by Google

COMET, 1886 I. (FABRY).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

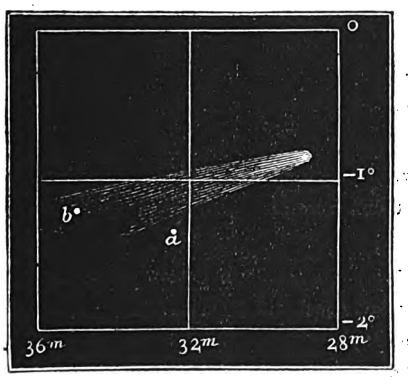
Date.	Cape Mean Time.	Comet—Star. Δα	Comet—Star. Δδ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\Delta$	Comet's Apparent Dec.	Log. $p\Delta$	Star's Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
May 1	6 39 12·3	+1 20·42	+6 3·0	6-6	G	4 6 36·01	9·6821	+ 5 19 22·2	0·7021$_n$	−0·56 −11·3	1
2	6 50 36·5	−0 40·19	−0 42·0	10-10	F	4 32 9·67	9·6757	− 0 38 23·1	0·6895$_n$	−0·55 −12·8	2
	7 6 57·9	−0 23·52	−4 38·5	11-11	F	4 32 26·34	9·6826	− 0 42 19·6	0·6897$_n$	−0·55 −12·8	2
3	6 52 17·2	+0 59·52	+2 6·4	16-16	F	4 56 7·61	9·6671	− 6 13 25·8	0·6645$_n$	−0·55 −14·2	3
4	6 33 32·8	−1 18·73	−4 15·5	12-12	F	5 18 0·53	9·6424	−11 10 17·2	0·6170$_n$	−0·53 −15·8	4
	7 22 21·2	+0 31·78	−0 51·4	12-12	F	5 18 43·57	9·6805	−11 19 47·1	0·6441$_n$	−0·54 −15·7	5
5	6 26 37·3	+1 40·57	−5 49·3	4-4	G	5 38 6·89	9·6236	−15 29 48·8	0·5597$_n$	−0·52 −17·0	6
6	6 48 44·8	+0 40·54	+1 17·8	20-16	F	5 36 34·83	9·6412	−19 13 29·4	0·5234$_n$	−0·49 −18·3	7
10	7 58 41·1	−1 58·12	+4 12·6	11-11	G	6 52 10·28	9·7055	−28 45 12·7	0·4513$_n$	−0·32 −21·8	8
11	8 21 13·6	−0 50·74	+6 1·3	22-10	F	7 2 30·69	9·7246	−30 13 43·6	0·4673$_n$	−0·30 −22·3	9
12	8 13 31·4	+1 53·34	+0 24·5	16-12	F	7 11 34·35	9·7199	−31 26 47·1	0·4202$_n$	−0·28 −22·5	10
13	7 49 13·4	−1 4·58	−1 14·6	20-16	F	7 19 37·94	9·6959	−32 28 14·5	0·3218$_n$	−0·23 −23·0	11
16	7 57 54·4	−0 28·57	+3 14·0	16-12	F	7 39 53·64	9·7090	−34 48 36·5	0·2723$_n$	−0·16 −23·6	12
17	7 46 35·6	+0 49·95	+4 4·5	20-16	F	7 45 26·40	9·6963	−35 23 36·9	0·2063$_n$	−0·14 −23·7	13
21	7 59 48·0	+0 14·74	−3 37·4	10-8	F	8 3 48·69	9·7184	−37 9 42·7	0·1981$_n$	−0·08 −23·8	14
22	7 43 14·7	−1 5·92	+5 34·0	20-16	F	8 7 34·63	9·7001	−37 29 43·3	0·1080$_n$	−0·05 −24·1	15
28	8 7 31·9	−1 49·21	−4 4·0	16-12	F	8 26 18·56	9·7436	−39 1 42·9	0·2067$_n$	0·00 −23·9	16
29	7 53 55·6	+0 18·28	−1 14·7	20-16	F	8 28 53·14	9·7308	−39 13 32·8	0·1331$_n$	−0·02 −23·9	17
June 6	8 25 16·4	−1 5·08	+1 27·1	12-12	F	8 46 37·21	9·7817	−40 32 24·9	0·3180$_n$	−0·01 −23·2	18
7	7 33 27·6	+0 40·39	−2 5·2	12-12	F	8 48 29·23	9·7352	−40 40 40·5	0·0545$_n$	−0·01 −23·2	19
10	8 12 3·6	−0 13·48	−4 59·7	12-12	F	8 54 3·30	9·7817	−41 5 28·5	0·2862$_n$	−0·01 −22·9	20
12	7 45 11·1	+0 24·86	+4 12·8	12-12	F	8 57 31·62	9·7646	−41 21 11·5	0·1713$_n$	−0·01 −22·8	21
22	8 3 40·1	+0 5·51		20-0	F	9 13 35·57	9·8053			−0·02 −21·6	22
	8 14 42·3		+0 3·2	0-6	F			−42 38 33·8	0·3854$_n$	−0·02 −21·6	22
23	8 11 2·5	−0 49·07		12-0	F	9 15 6·52	9·8109			−0·02 −21·5	23
	8 11 2·5		−1 37·0	0-16	F			−42 46 17·5	0·3857$_n$	−0·02 −21·5	24
26	7 25 41·7		−2 21·1	0-6	F			−43 9 30·6	0·1927$_n$	−0·03 −21·1	25
	7 34 1·0	+0 25·46		8-0	F	9 19 32·65	9·7959			−0·03 −21·1	25

Digitized by Google

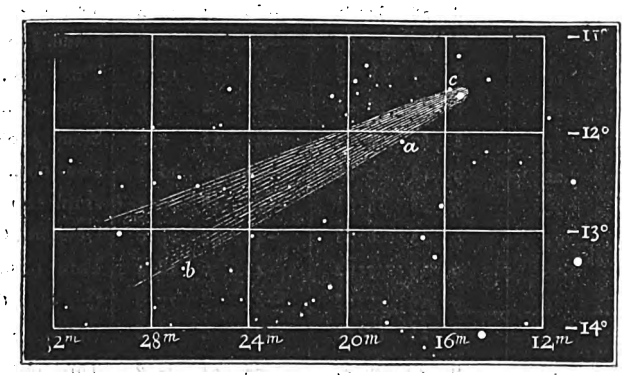
COMET, 1886 I. (FABRY)—*continued.*

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\Delta$	Comet's Apparent Dec.	Log. $p\Delta$	Star's Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 3	7 29 49·3	+0 27·12	−2 40·2	10–10	F	9 29 39·01	9·8117	−44 6 12·3	0·2844$_n$	−0·04 −20·1	26
5	8 4 9·9		−0 58·7	0–4	F			−44 23 14·3	0·4395$_n$	−0·06 −19·8	27
	8 13 20·8	+1 34·23		4–0	F	9 32 30·74	9·8337			−0·06 −19·8	27
6	7 4 3·0	−0 26·52	−1 33·3	12–12	F	9 33 52·54	9·8019	−44 31 23·8	0·1791$_n$	−0·04 −19·7	28
7	7 3 30·5		−0 7·0	0–10	F			−44 39 57·0	0·1868$_n$	−0·05 −19·6	29
	7 26 57·8	+0 11·26		14–0	F	9 35 17·05	9·8200			−0·05 −19·6	29
8	7 19 20·8	−0 23·15	+0 47·0	10–12	F	9 36 41·35	9·8182	−44 48 45·9	0·2800$_n$	−0·04 −19·4	30
20	7 26 53·2	−0 18·26	−1 10·2	12–8	F	9 53 11·78	9·8495	−46 39 34·8	0·4194$_n$	−0·06 −17·6	31
26	7 40 10·0	−0 51·20	−0 17·8	8–8	F	10 1 23·27	9·8619	−47 39 39·0	0·5069$_n$	−0·06 −16·6	32
30	7 54 42·4	−0 14·50	+1 0·2	6–4	F	10 6 48·28	9·8658	−48 21 29·6	0·5760$_n$	−0·07 −15·9	33



Comet Fabry, May 2, 7h 15m Cape Mean Time (on Argelander's Map).



Comet Fabry, May 4, 8h 5m Cape Mean Time (on the Berlin Star Maps).

Notes.

May 4. Excellent observations; star-like nucleus of 9th magnitude; admits of as easy observation as a star.
5. Observations difficult on account of haze.
12, 13. Good observations; star-like nucleus of 9½ magnitude.
21. Haze constantly blotting out comet.
June 22. Comet faint.
July 5. Comet near a 10½ magnitude star, and very faint. Definition exceedingly bad.
6, 8. Very faint; moonlight.
26, 30. Small and faint.

Digitized by Google

COMET, 1886 I. (FABRY).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1886·0.			Dec. 1886·0.			Authority.
	h	m	s	°	′	″	
1	4	5	16·15	+ 5	13	30·5	Greenwich 7-year and 9-year Cat.
2	4	32	50·41	− 0	37	28·3	Four obs., Cape, 1887.
3	4	55	8·64	− 6	15	18·0	Five obs., Cape, 1887.
4	5	19	19·79	−11	5	45·9	Four obs., Cape, 1887.
5	5	18	12·33	−11	18	40·0	Four obs., Cape, 1887.
6	5	36	26·84	−15	23	42·5	Four obs., Cape, 1887.
7	5	55	54·78	−19	14	28·9	Five obs., Cape, 1887 and 1889.
8	6	54	8·72	−28	49	3·5	Nautical Almanac.
9	7	3	21·73	−30	19	22·6	Four obs., Cape, 1887.
10	7	9	41·29	−31	26	49·1	Three obs., Cape, 1887.
11	7	20	42·75	−32	26	36·9	Four obs., Cape, 1887.
12	7	40	22·37	−34	51	26·9	Three obs., Cape, 1887.
13	7	44	36·59	−35	27	17·7	Four obs., Cape, 1887.
14	8	3	34·03	−37	5	41·5	Gould, 10,788. One obs., Cape, 1887.
15	8	8	40·60	−37	34	53·2	Gould. Stone. One obs., Cape, 1887.
16	8	28	7·77	−38	57	15·0	Four obs., Cape, 1887.
17	8	28	34·88	−39	11	54·2	Two obs., Cape, 1887.
18	8	47	42·30	−40	33	28·8	Stone, 4707.
19	8	47	48·85	−40	38	12·1	Three obs., Cape, 1887.
20	8	54	16·79	−41	0	5·9	Three obs., Cape, 1887.
21	8	57	6·77	−41	25	1·6	Stone, 4803.
22	9	13	30·08	−42	38	15·4	Four obs., Cape, 1887.
23	9	15	55·61	−42	48	50·0	Dupl. 10 mag. Equat. diff. from 24.
24	9	15	8·23	−42	44	19·0	One obs., Cape, 1887.
25	9	19	7·22	−43	6	48·4	Three obs., Cape, 1887.
26	9	29	11·93	−44	3	12·0	One obs., Cape, 1887: and equat. diff. from *a*.
a	9	25	11·22	−44	2	0·5	Gould, 12,956. Stone, 5098.
27	9	30	56·57	−44	21	55·8	Three obs., Cape, 1887.
28	9	34	19·10	−44	29	30·8	Three obs., Cape, 1887 and 1889.
29	9	35	5·84	−44	39	30·4	Two obs., Cape, 1887 and 1889.
b	9	34	45·34	−44	54	41·4	One obs., Cape, 1887.
30	9	37	4·54	−44	49	13·5	10½ mag. Equat. diff. from *b*.
31	9	53	30·10	−46	38	7·0	10½ mag. Equat. diff. from *c*.
c	9	54	45·20	−46	32	48·6	One obs., Cape, 1887. Gould.
32	10	2	14·53	−47	39	4·6	10½ mag. Equat. diff. from *d*.
d	10	3	6·66	−47	42	14·1	Gould, 13,817. Stone, 5497.
33	10	7	2·85	−48	22	13·9	Cord. Zones, X. 493.

Digitized by Google

COMET, 1886 II. (BARNARD).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δα	Comet—Star. Δδ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Stars Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
May 29	6 1 20·9	+0 47·59	−0 27·3	8–8	F	4 33 49·34	9·7095	−16 57 49·9	0·6685$_n$	−0·71 − 9·2	1
June 1	6 10 6·7	−1 25·32	−6 14·7	6–4	F	5 12 2·40	9·7413	−27 42 58·3	0·6059$_n$	−0·88 −11·1	2
5	6 37 12·8	+0 28·98	−7 57·3	4–4	F	5 59 37·79	9·7890	−37 40 50·8	0·5288$_n$	−1·04 −13·8	3
6	6 25 11·7	−0 11·20	−2 20·8	20–16	F	6 10 23·17	9·7942	−39 27 35·4	0·4596$_n$	−1·06 −14·5	4
7	6 8 34·6		−6 16·2	0–6	F			−41 1 2·4	0·3609$_n$	−1·06 −15·2	5
	6 23 14·6	−1 19·88		10–0	F	6 20 46·59	9·8008			−1·06 −15·2	5
	6 35 45·2	−0 10·94		10–0	F	6 20 52·07	9·8058			−1·06 −15·4	6
	6 44 44·5		+2 39·7	0–6	F			−41 3 14·7	0·4818$_n$	−1·06 −15·4	6
10	6 42 22·7	+1 29·90	−3 34·0	12–8	F	6 49 21·33	9·8274	−44 41 55·8	0·3716$_n$	−1·08 −16·7	7
	7 13 50·4	−0 17·07	+4 30·7	10–8	F	6 49 32·72	9·8366	−44 43 11·4	0·4833$_n$	−1·07 −16·8	8
12	6 55 56·0	−0 40·77	−3 25·1	20–12	F	7 6 10·77	9·8433	−46 27 39·6	0·3656$_n$	−1·05 −17·7	9
15	7 31 39·5		−2 47·7	0–4	F			−48 24 58·5	0·4405$_n$	−1·01 −18·5	10
	7 41 38·4	+1 31·32		6–0	F	7 28 32·09	9·8677			−1·01 −18·5	10
22	8 42 40·7		+0 42·2	0–4	F			−51 5 58·4	0·6026$_n$	−0·81 −20·1	11
	8 54 54·4	−4 5·35		4–0	F	8 19 19·50	9·8821			−0·81 −20·1	11
23	7 26 39·9	−0 11·38	+0 22·2	14–12	F	8 13 50·69	9·8880	−51 20 42·9	0·3162$_n$	−0·82 −19·9	12
July 5	7 25 17·0	+1 49·85	+5 20·4	10–8	F	8 59 46·41	9·9090	−53 28 39·3	0·2781$_n$	−0·64 −19·8	13
6	7 58 33·9	−0 7·63	+1 13·4	19–12	F	9 2 57·84	9·9169	−53 36 59·1	0·4407$_n$	−0·60 −19·8	14
7	8 0 27·6	+1 23·23	+5 14·4	10–14	F	9 6 0·12	9·9184	−53 45 0·3	0·4514$_n$	−0·61 −19·6	15
8	7 58 4·9	+0 9·01	−3 53·7	9–8	F	9 8 58·35	9·9197	−53 52 53·6	0·4459$_n$	−0·58 −19·6	16
20	8 2 45·8		+5 52·1	0–4	F			−55 24 0·7	0·5103$_n$	−0·46 −18·4	17
	8 18 21·2	−1 2·46		9–0	F	9 40 9·73	9·9317			−0·46 −18·4	17
21	6 34 48·6		−1 23·3	0–4	F			−55 31 16·1	0·9816$_n$	−0·46 −18·4	17
	6 41 27·1	+1 7·52		4–0	F	9 42 19·71	9·9207			−0·46 −18·4	17
24	7 25 50·1		−3 4·2	0–4	F			−55 55 1·1	0·3768$_n$	−0·44 −17·8	18
	7 40 6·5	−0 10·49		12–0	F	9 49 14·07	9·9417			−0·44 −17·8	18
26	8 20 41·0	−1 8·03	−3 1·8	6–6	F	9 53 43·99	9·9363	−56 11 4·2	0·5938$_n$	−0·42 −17·6	19

Notes.

June 15. Moonlight too strong.
July 5. Faint: very bad definition.
6. Faint: moonlight.
8. Large, faint and diffused: difficult.
20. Very faint, and so mixed up with two stars that it was almost impossible to fix its position.
21. Cloudy night: observations not of much value.
24. Exceedingly faint: definition very bad.
26. An exceedingly faint and ill-defined patch of light.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1886·0.	Dec. 1886·0.	Authority.	Star.	R.A. 1886·0.	Dec. 1886·0.	Authority.
	h m s	° ′ ″			h m s	° ′ ″	
1	4 33 2·46	−16 57 13·4	Four obs., Cape, 1887.	10	7 27 1·78	−48 21 52·3	Three obs., Cape, 1887.
2	5 13 28·60	−27 36 32·5	Three obs., Cape, 1887. Gould, 6099, 6100.	11	8 13 25·66	−51 6 20·5	Four obs., Cape, 1887.
				12	8 14 2·89	−51 20 45·2	Three obs., Cape, 1887.
3	5 59 9·85	−37 32 39·7	Stone, 2762. Gould, 7212.	13	8 57 57·20	−53 33 39·9	Five obs., Cape, 1887.
4	6 10 35·43	−39 25 0·1	Four obs., Cape, 1887.	14	9 3 6·07	−53 37 52·7	Four obs., Cape, 1887.
5	6 22 7·53	−40 54 31·0	Stone, 2995.	15	9 4 37·50	−53 49 55·1	Four obs., Cape, 1887.
6	6 21 4·07	−41 5 39·0	10 mag. Equat. diff. from *a*.	16	9 8 49·92	−53 48 40·3	Three obs., Cape, 1887.
				17	9 41 12·65	−55 29 34·4	Three obs., Cape, 1887.
a	6 24 9·57	−41 3 47·7	Stone, 3017.	18	9 49 25·00	−55 51 39·1	Three obs., Cape, 1887.
7	6 47 52·51	−44 38 5·1	Four obs., Cape, 1887.	19	9 54 52·44	−56 7 44·8	Two obs., Cape, 1887.
8	6 49 50·86	−44 47 25·2	Three obs., Cape, 1887.				
9	7 6 52·59	−46 23 56·8	Five obs., Cape, 1887.				

Digitized by Google

COMET, 1886 V. (BROOKS).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 5	6 31 14·3	−1 22·96	+3 30·5	6–4	F	8 24 20·14	9·6810	− 9 0 7·0	0·6589$_n$	−0·03 −11·6	1
6	6 18 46·5	−0 27·10	+3 53·1	16–16	F	8 30 42·32	9·6735	− 9 15 27·5	0·6512$_n$	−0·01 −11·6	2
7	6 26 17·1	+0 31·60	−2 3·6	20–16	F	8 36 56·50	9·6768	− 9 29 55·2	0·6523$_n$	0·00 −11·5	3
8	6 33 31·7	+1 3·55	+1 17·6	16–12	F	8 43 36·82	9·6799	− 9 42 7·0	0·6537$_n$	+0·02 −11·5	4
9	6 30 55·9		+0 27·2	0–16	F			− 9 55 26·7	0·6501$_n$	+0·04 −11·5	5
	6 41 14·6	+0 1·23		30–0	F	8 48 51·12	9·6827			+0·04 −11·5	5
12	6 48 53·1	−2 29·03	−7 29·3	4–4	F	9 5 15·40	9·6853	−10 27 23·1	0·6552$_n$	+0·10 −11·4	6
14	6 32 30·5	+1 3·07	−2 6·4	10–8	F	9 15 17·91	9·6755	−10 45 1·5	0·6432$_n$	+0·13 −11·2	7
	6 32 30·5	−0 46·02	+0 7·7	10–8	F	9 15 17·90	9·6755	−10 45 0·0	0·6432$_n$	+0·13 −11·2	8
20	6 39 1·1	+0 54·38	−1 32·0	16–10	F	9 42 9·28	9·6789	−11 26 25·3	0·6417$_n$	+0·22 −10·7	9
	6 39 1·1	−0 38·05	+1 14·2	16–10	F	9 42 9·30	9·6789	−11 26 26·2	0·6417$_n$	+0·22 −10·7	10
24	6 49 10·1	+0 33·75	−2 5·2	14–8	F	9 57 39·23	9·6849	−11 47 23·1	0·6461$_n$	+0·27 −10·3	11
26	6 41 26·3	+1 45·79	+1 16·3	10–8	F	10 4 47·01	9·6815	−11 56 34·5	0·6409$_n$	+0·29 −10·1	12
28	6 37 15·7	−0 52·36	+1 4·0	8–6	F	10 11 32·83	9·6800	−12 5 6·9	0·6382$_n$	+0·32 − 9·8	13
29	6 41 55·1	+0 19·19	−1 23·9	10–8	F	10 14 49·80	9·6829	−12 9 5·2	0·6411$_n$	+0·33 − 9·7	14
30	6 46 25·4	−1 49·76	−1 57·2	8–8	F	10 18 2·24	9·6861	−12 13 9·7	0·6446$_n$	+0·35 − 9·6	15

Notes.

July 5. A bright circular mass, about $\frac{3}{4}'$ in diameter, gradually condensed toward the centre.
12. Hazy sky: observations rough.
14. Comet very faint: bright moonlight.
20. A diffused mass without any particular condensation.
24. Definition bad. A rather faint diffused patch of light: does not admit of very accurate observation.
29. Faint and ill-defined. A difficult object to observe.
30. Very faint.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1886·0.	Dec. 1886·0.	Authority.
	h m s	° ′ ″	
1	8 25 43·13	− 9 3 25·9	Three obs., Cape, 1887.
2	8 31 9·43	− 9 19 9·0	Four obs., Cape, 1887.
3	8 36 24·90	− 9 27 40·1	Four obs., Cape, 1887.
a	8 41 5·85	− 9 48 34·0	Three obs., Cape, 1887.
4	8 42 33·25	− 9 43 13·1	10½ mag. Equat. diff. from *a*.
5	8 48 49·85	− 9 55 42·4	10½ mag. Equat. diff. from *b*.
b	8 51 15·15	− 9 53 53·0	Six obs., Cape, 1887.
6	9 7 44·33	−10 19 42·4	Three obs., Cape, 1887.
7	9 14 14·71	−10 42 43·9	Two obs., Cape, 1887.
8	9 16 3·79	−10 44 56·5	One obs., Cape, 1887.
9	9 41 14·68	−11 24 42·6	Four obs., Cape, 1887.
10	9 42 47·13	−11 27 29·7	Four obs., Cape, 1887.
11	9 57 5·21	−11 45 7·6	Four obs., Cape, 1887.
12	10 3 0·93	−11 57 40·7	Three obs., Cape, 1887.
13	10 12 24·87	−12 6 1·1	Four obs., Cape, 1887.
14	10 14 30·28	−12 7 31·6	Four obs., Cape, 1887.
15	10 19 51·65	−12 11 2·9	Four obs., Cape, 1887.

Digitized by Google

COMET, 1886 VI. (WINNECKE).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Star's Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Aug. 19	8 12 28·8	−0 44·77	−3 5·7	3–5	F	13 7 5·47	9·6739	− 0 34 1·4	0·6895$_n$	+0·83 − 0·9	1
20	7 1 49·9	+0 50·87	+0 17·1	16–12	F	13 10 21·40	9·6131	− 1 8 17·3	0·6842$_n$	+0·84 − 1·0	2
20	7 39 2·0	−1 10·10	−4 16·3	10–8	F	13 10 26·72	9·6514	− 1 9 15·9	0·6859$_n$	+0·85 − 0·9	3
21	7 12 7·4	+1 37·91	−0 26·1	12–12	F	13 13 50·72	9·6260	− 1 45 3·9	0·6810$_n$	+0·85 − 1·0	4
22	6 47 5·3	+0 13·99	−1 21·0	12–12	F	13 17 17·47	9·5955	− 2 21 20·7	0.6748$_n$	+0·87 − 0·9	5
25	7 35 35·4	−1 18·82	+4 56·2	11–8	F	13 28 11·67	9·6514	− 4 16 2·5	0·6697$_n$	+0·92 − 0·7	6
29	7 28 34·7	+0 27·69	+3 0·5	12–12	F	13 43 9·99	9·6478	− 6 53 13·4	0·6529$_n$	+0·98 − 0·6	7
Sept. 4	7 35 10·9	−0 35·33	+4 29·8	12–12	F	14 7 9·79	9·6575	−11 1 3·7	0·6272$_n$	+1·02 − 0·9	8
16	7 43 5·3		+5 6·4	0–4	F			−19 41 48·4	0·5583$_n$	+1·27 + 0·2	9
16	7 49 59·2	+1 2·77		3–0	F	15 1 51·41	9·6825			+1·27 + 0·2	9
17	7 38 19·5	−1 42·06	−0 16·1	16–12	F	15 6 50·41	9·6738	−20 25 13·8	0·5439$_n$	+1·31 + 0·4	10
18	7 36 44·7	+0 46·16	+0 32·6	16–12	F	15 11 56·57	9·6734	−21 8 34·3	0·5328$_n$	+1·31 + 0·3	11
19	7 31 29·1	−0 9·45	+5 4·4	8–8	F	15 17 7·38	9·6693	−21 51 35·2	0·5160$_n$	+1·34 + 0·4	12
20	7 25 58·6	−0 1·36	−2 15·4	26–12	F	15 22 22·71	9·6645	−22 34 19·8	0·4976$_n$	+1·36 + 0·5	13
25	7 52 47·7	−1 50·32	−2 18·1	16–12	F	15 50 11·82	9·6945	−26 3 17·3	0·4854$_n$	+1·47 + 1·0	14
26	7 40 35·3	−0 51·32	−2 15·1	16–12	F	15 55 57·83	9·6837	−26 42 56·3	0·4497$_n$	+1·49 + 1·1	15
27	9 9 22·4	+1 5·14	+0 53·6	10–8	F	16 2 13·96	9·7390	−27 24 32·0	0·5984$_n$	+1·51 + 1·1	16
30	8 50 12·4	+0 12·83	−4 23·5	16–12	F	16 20 24·19	9·7382	−29 16 36·7	0·5405$_n$	+1·57 + 1·5	17
Oct. 1	8 32 3·4		−3 19·3	0–4	F			−29 51 49·6	0·4940$_n$	+1·59 + 1·6	18
1	8 41 7·9	+1 43·80		3–0	F	16 26 37·59	9·7351			+1·59 + 1·6	18
15	8 23 40·9	−0 39·12	+1 45·0	12–12	F	18 1 2·19	9·7182	−35 54 33·9	0·2566$_n$	+1·88 + 4·0	19
18	8 28 26·5	−0 16·10	+1 24·7	16–12	F	18 22 5·82	9·7174	−36 33 8·5	0·2254$_n$	+1·92 + 4·6	20
19	8 39 2·7	−0 29·02	+4 10·3	16–12	F	18 29 8·23	9·7265	−36 42 45·7	0·2526$_n$	+1·94 + 4·8	21
21	9 8 57·4	+0 20·13	−0 37·7	16–12	F	18 43 10·08	9·7506	−36 57 7·9	0·3371$_n$	+1·95 + 5·2	22
22	8 14 23·9	+1 18·95	−0 46·3	12–12	F	18 49 48·12	9·6864	−37 1 50·0	0·0840$_n$	+1·96 + 5·4	23
29	9 1 40·3		−0 43·0	0–4	F	19 36 38·8		−36 54 20·0	0·2200$_n$	+2·01 + 6·7	24
31	8 30 21·9		+0 5·7	0–4	F			−36 40 29·8	0·0494$_n$	+2·03 + 7·1	25
31	8 41 4·9	−0 18·65		6–0	F	19 49 6·36	9·6884			+2·03 + 7·1	25
Nov. 2	8 12 45·7	−1 11·85	−0 25·4	10–8	F	20 1 13·96	9·6327	−36 22 14·7	9·9378$_n$	+2·03 + 7·5	26
13	8 1 12·3		+2 37·7	0–4	F			−33 40 25·6	9·9354$_n$	+2·04 + 9·0	27
13	8 11 32·1	−0 26·34			F	21 1 26·51	9·6809			+2·04 + 9·0	27
17	9 15 15·6		+2 36·4	0–4	F			−32 23 7·2	0·2827$_n$	+2·04 + 9·5	28
17	9 23 36·6	+0 23·17		10–0	F	21 20 35·33	9·6900			+2·04 + 9·5	28
19	9 42 58·4	+1 46·70	−0 7·7	5–5	F	21 29 33·34	9·7070	−31 42 30·4	0·3755$_n$	+2·03 + 9·6	29
23	8 37 8·6	+0 32·88	+0 51·7	8–8	F	21 46 9·31	9·6070	−30 20 6·0	0·2124$_n$	+2·05 +10·0	30
25	8 55 16·9	+1 9·11	−1 8·1	8–10	F	21 54 7·73	9·6351	−29 36 59·3	0·2866$_n$	+2·03 +10·1	31
26	9 21 36·0	−1 41·73	+0 10·3	10–8	F	21 58 3·06	9·6709	−29 15 11·6	0·3631$_n$	+2·04 +10·1	32
29	9 9 15·4	+0 48·73	+5 39·9	10–8	F	22 9 7·33	9·6510	−28 10 24·0	0·3566$_n$	+2·03 +10·1	33

Notes.

Aug. 25. Observations made through cloud: not very good.
Sept. 4. Bright moonlight: comet faint.
16. Comet seen during a short break in the clouds.
18. Well condensed towards centre, but scarcely a stellar nucleus.
Oct. 1. Moonlight and clouds: observations not very valuable.
29. Clouds prevented further observations.
Nov. 2. Faint in the moonlight.
17. Faint from this date onwards.

Digitized by Google

COMET, 1886 VI. (WINNECKE).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1886·0.			Dec. 1886·0.			Authority.
	h	m	s	°	′	″	
1	13	7	49·41	− 0	30	54·8	Three obs., Cape, 1887.
2	13	9	29·69	− 1	8	33·4	Three obs., Cape, 1887.
3	13	11	35·97	− 1	4	58·7	Four obs., Cape, 1887.
4	13	12	11·96	− 1	44	36·8	Four obs., Cape, 1887.
5	13	17	2·61	− 2	19	58·8	Four obs., Cape, 1887.
6	13	29	29·57	− 4	20	58·0	Three obs., Cape, 1887.
7	13	42	41·32	− 6	56	13·3	10½ mag. Equat. diff. from *a*.
a	13	44	33·32	− 7	1	51·7	Three obs., Cape, 1887.
8	14	7	44·10	−11	5	32·6	Four obs., Cape, 1887.
9	15	0	47·37	−19	46	55·0	Four obs., Cape, 1887.
10	15	8	31·16	−20	24	58·1	Four obs., Cape, 1887.
11	15	11	9·10	−21	9	7·2	Three obs., Cape, 1887.
12	15	17	15·49	−21	56	40·0	Three obs., Cape, 1887.
13	15	22	22·71	−22	32	4·9	Three obs., Cape, 1887.
14	15	52	0·67	−26	1	0·2	Three obs., Cape, 1887.
15	15	56	47·66	−26	40	42·3	Three obs., Cape, 1887.
16	16	1	7·31	−27	25	26·7	C.G.A., 21,858.
17	16	20	9·79	−29	12	14·7	Three obs., Cape, 1887.
18	16	24	52·20	−29	48	31·9	Three obs., Cape, 1887.
19	18	1	39·43	−35	56	22·9	Three obs., Cape, 1887.
20	18	22	20·00	−36	34	37·8	Three obs., Cape, 1887.
21	18	29	35·31	−36	47	0·8	Four obs., Cape, 1887.
22	18	42	48·00	−36	56	35·4	C.G.A., 25,730.
23	18	48	27·21	−37	1	9·1	Three obs., Cape, 1887.
24	19	34	39·04	−36	53	43·7	Stone, 10,615. Cord. Zones, 19h, 1443.
25	19	49	22·98	−36	40	42·6	Three obs., Cape, 1887.
26	20	2	23·78	−36	21	56·8	Four obs., Cape, 1887.
27	21	1	50·81	−33	43	12·3	Three obs., Cape, 1887.
28	21	20	10·12	−32	25	53·1	Four obs., Cape, 1887.
29	21	27	44·61	−31	42	32·3	Three obs., Cape, 1887.
30	21	45	34·38	−30	21	7·7	Three obs., Cape, 1887.
31	21	52	56·59	−29	36	1·3	Stone, 11,567. C.G.A., 30,070.
32	21	59	42·75	−29	15	32·0	C.G.A., 30,216.
33	22	8	16·57	−28	16	14·0	Four obs., Cape, 1887.

Digitized by Google

COMET, 1886 VII. (FINLAY).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δα	Comet—Star. Δδ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p	Comet's Apparent Dec.	Log. $p\Delta$	Star's Red. to App. Place.	Comp. Star.
1886.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Sept. 26	9 14 40·8	−1 29·21	+1 37·7	14–12	F	17 2 1·57	9·7046	−26 4 10·5	0·5069$_n$	+1·82 + 4·2	1
27	8 28 10·1	+0 49·66	−1 19·9	12–10	F	17 4 20·42	9·6628	−26 7 8·2	0·4266$_n$	+1·80 + 4·3	1
27	9 38 24·5	+0 56·56	−1 26·5	8–8	F	17 4 27·32	9·7220	−26 7 14·6	0·5528$_n$	+1·80 + 4·3	1
29	9 19 7·7	+1 55·16	−2 29·0	6–6	F	17 9 19·61	9·7129	−26 13 5·8	0·5247$_n$	+1·78 + 4·5	2
30	7 56 12·6	+0 25·06	−4 25·7	24–16	F	17 11 42·17	9·6253	−26 15 48·2	0·3690$_n$	+1·78 + 4·7	3
Oct. 1	7 53 16·0	−0 5·93	+0 32·4	6–6	F	17 14 15·73	9·6231	−26 18 30·2	0·3647$_n$	+1·78 + 4·8	4
2	7 30 48·6		+1 54·2	0–4	F			−26 21 4·3	0·3212$_n$	+1·76 + 4·8	5
2	8 2 19·4	+2 31·03		15–0	F	17 16 53·92	9·6389			+1·76 + 4·8	5
5	7 57 55·6	+2 3·18	+2 5·4	10–8	F	17 24 58·96	9·6383	−26 28 3·3	0·3816$_n$	+1·75 + 5·2	6
10	7 43 26·3	+0 46·50	−0 25·3	4–4	F	17 39 21·84	9·6246	−26 36 20·9	0·3597$_n$	+1·74 + 6·0	7
15	7 39 44·4	+0 13·67	−2 11·6	16–12	F	17 54 55·09	9·6260	−26 39 23·4	0·3594$_n$	+1·72 + 6·7	8
18	7 42 50·8	+0 36·83	+1 42·1	20–12	F	18 4 49·11	9·6337	−26 38 10·7	0·3711$_n$	+1·71 + 7·2	9
19	7 42 36·9	−0 57·66	+0 25·7	16–12	F	18 8 12·74	9·6339	−26 37 9·2	0·3715$_n$	+1·72 + 7·4	10
21	8 0 49·3	−1 54·99	−4 3·8	16–12	F	18 15 10·79	9·6600	−26 34 13·1	0·4119$_n$	+1·72 + 7·7	11
21	8 0 49·3	−2 24·65	−1 16·4	16–12	F	18 15 10·75	9·6600	−26 34 13·8	0·4119$_n$	+1·72 + 7·7	12
22	8 15 25·9	+1 9·33	+0 45·1	23–12	F	18 18 44·71	9·6774	−26 32 12·2	0·4422$_n$	+1·70 + 7·8	12
26	7 52 23·1	−1 28·60	+3 14·9	10–8	F	18 33 16·88	9·6504	−26 20 40·7	0·4022$_n$	+1·71 + 8·4	13
29	7 46 36·0		+1 0·7	0–4	F			−26 7 48·4	0·3958$_n$	+1·70 + 8·8	14
29	8 3 15·6	+0 34·82		10–0	F	18 44 44·55	9·6645			+1·70 + 8·8	14
30	7 42 52·9		+1 55·0	0–6	F			−26 2 39·1	0·3885$_n$	+1·70 + 9·0	15
30	8 3 32·5	−0 7·99		14–0	F	18 48 38·74	9·6634			+1·70 + 9·0	15
Nov. 13	8 49 3·9	−0 9·42	+1 39·4	12–8	F	19 47 58·98	9·6967	−23 54 59·1	0·5288$_n$	+1·71 +11·2	16
17	8 25 12·9	+0 50·63	−0 10·6	11–8	F	20 6 15·95	9·6701	−22 56 59·1	0·4994$_n$	+1·70 +11·7	17
19	8 8 4·2	+0 32·73	−2 19·5	16–12	F	20 15 36·07	9·6471	−22 23 56·6	0·4787$_n$	+1·72 +12·1	18
22	8 14 26·6	−0 45·30	+1 3·1	24–12	F	20 29 57·54	9·6490	−21 28 49·3	0·4965$_n$	+1·74 +12·6	19
23	8 7 41·4	−0 11·38	+3 38·9	20–12	F	20 34 46·62	9·6386	−21 9 5·2	0·4905$_n$	+1·74 +12·7	20
25	8 9 12·6	−0 28·86	−2 12·4	16–12	F	20 44 33·08	9·6360	−20 27 13·1	0·4996$_n$	+1·76 +13·0	21
26	8 8 58·8	−0 20·75	−4 40·9	16–12	F	20 49 28·54	9·6335	−20 5 16·1	0·5030$_n$	+1·74 +13·0	22
29	8 12 24·6	+0 26·75	+0 19·7	16–12	F	21 4 25·00	9·6308	−18 54 42·8	0·5182$_n$	+1·78 +13·4	23
Dec. 4	8 30 36·8		+3·34·0	0–8	F			−16 42 30·4	0·5569$_n$	+1·81 +14·0	24
6	8 50 4·2	+0 7·71	+1 18·1	20–12	F	21 40 4·69	9·6568	−15 44 30·1	0·5821$_n$	+1·84 +14·3	25
13	8 34 48·4	−1 31·33	+0 48·2	12–8	F	22 16 7·02	9·6235	−12 3 42·2	0·5987$_n$	+1·92 +14·9	26
15	8 36 46·0	−1 18·35	+0 38·1	22–12	F	22 26 28·15	9·6217	−10 55 42·9	0·6091$_n$	+1·97 +15·0	27
16	8 27 23·6	−0 25·81	+3 59·0	12–8	F	22 31 36·21	9·6067	−10 21 15·9	0·6086$_n$	+1·98 +15·1	28
17	8 30 20·5	−0 16·05	−1 24·1	18–12	F	22 36 46·78	9·6086	− 9 46 8·1	0·6150$_n$	+2·00 +15·2	29
18	8 34 51·6	−0 26·72	+0 19·4	18–12	F	22 41 56·81	9·6121	− 9 10 39·6	0·6219$_n$	+2·01 +15·2	30
23	8 46 45·6	−1 53·18	+0 6·3	14–12	F	23 7 38·91	9·6163	− 6 9 7·3	0·6490$_n$	+2·11 +15·4	31
27	8 50 22·1	+0 50·33	−2 45·6	16–12	F	23 27 56·31	9·6138	− 3 41 14·2	0·6668$_n$	+2·18 +15·5	32
28	8 47 1·9	−0 27·83	−0 24·6	16–12	F	23 32 57·07	9·6080	− 3 4 19·4	0·6706$_n$	+2·21 +15·4	33

Notes.

Sept. 26. Faint, round, very slightly more condensed towards the centre.
27. The second set of observations is the better: during the first set the comet was approaching a star, 11 mag., which completely overpowered it at last.
Oct. 1. Hazy night: comet close enough to the comparison star to be rendered rather difficult.
5, 10. Moonlight.
26. Hazy.
Nov. 25. Strong S.E. wind: the central condensation seemed somewhat elongated in position angle 165° ±, but the definition was very bad this night.
29. Very bad definition: strong wind.
Dec. 4. Chronograph failed: signals not recorded.

Digitized by Google

COMET, 1886 VII. (FINLAY).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1886·0.			Dec. 1886·0.			Authority.
	h	m	s	°	′	″	
1	17	3	28·96	−26	5	52·4	Equat. diff. from *a*.
a	17	6	14·56	−26	1	51·5	C.G.A., 23,302.
2	17	7	22·67	−26	10	41·3	Three obs., Cape, 1887.
3	17	11	15·33	−26	11	27·2	Three obs., Cape, 1887.
4	17	14	19·88	−26	19	7·4	Four obs., Cape, 1887.
5	17	14	21·13	−26	23	3·3	C.G.A. 23,483.
6	17	22	54·03	−26	30	13·9	Three obs., Cape, 1887.
7	17	38	33·60	−26	36	1·6	Five obs., Cape, 1887.
8	17	54	39·70	−26	37	18·5	Three obs., Cape, 1887.
9	18	4	10·57	−26	40	0·0	Four obs., Cape, 1887.
10	18	9	8·68	−26	37	42·3	Three obs., Cape, 1887.
11	18	17	4·06	−26	30	17·0	C.G.A. 25,072.
12	18	17	33·68	−26	33	5·1	Three obs., Cape, 1887.
13	18	34	43·77	−26	24	4·0	Five obs., Cape, 1887.
14	18	44	8·03	−26	8	57·9	Four obs., Cape, 1887.
15	18	48	45·03	−26	4	43·1	Three obs., Cape, 1887.
16	19	48	6·69	−23	56	49·7	Four obs., Cape, 1887.
17	20	5	23·62	−22	57	0·2	Three obs., Cape, 1887.
18	20	15	1·62	−22	21	49·2	Four obs., Cape, 1887.
19	20	30	41·10	−21	30	5·0	Four obs., Cape, 1887.
20	20	34	56·26	−21	12	56·8	Three obs., Cape, 1887.
21	20	45	0·18	−20	25	13·7	Three obs., Cape, 1887.
22	20	49	47·55	−20	0	48·2	Four obs., Cape, 1887.
23	21	3	56·47	−18	55	15·9	Three obs., Cape, 1887.
24	21	28	55·43	−16	46	18·4	Three obs., Cape, 1887.
25	21	39	55·14	−15	46	2·4	Four obs., Cape, 1887.
26	22	17	36·43	−12	4	45·3	Four obs., Cape, 1887.
27	22	27	44·53	−10	56	36·0	Five obs., Cape, 1887.
28	22	32	0·04	−10	25	30·0	Four obs., Cape, 1887 and 1890.
29	22	37	0·83	− 9	44	59·2	Four obs., Cape, 1887.
30	22	42	21·52	− 9	11	14·2	Three obs., Cape, 1887.
31	23	9	29·98	− 6	9	29·0	Four obs., Cape, 1887.
32	23	27	3·80	− 3	38	44·1	Karlsruhe Zones (Valentiner).
33	23	33	22·69	− 3	4	10·2	Four obs., Cape, 1887.

Digitized by Google

COMET, 1886 IX. (BARNARD-HARTWIG).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp Star.
1887.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Apr. 29	17 4 7·5	−2 29·13	−2 8·1	6-8	F	23 5 52·60	9·6454$_n$	−27 41 44·7	0·3582$_n$	−0·78 + 5·4	1
30	16 6 19·5	−1 0·20	−1 32·0	12-8	F	23 6 38·71	9·7060$_n$	−27 56 44·9	0·4710$_n$	−0·73 + 5·9	2
May 30	15 56 44·4	−0 13·83	+1 35·4	16-12	F	23 22 30·68	9·6261$_n$	−37 24 29·6	9·8116$_n$	−0·09 +14·7	3
June 16	14 1 49·7	+2 33·84	+1 11·4	12-12	F	23 21 59·56	9·7473$_n$	−44 4 21·6	9·7753$_n$	+0·49 +19·8	4

The comet was small and faint, with slight condensation towards the centre.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1887·0.	Dec. 1887·0.	Authority.
	h m s	° ′ ″	
1	23 8 22·51	−27 39 42·0	Three obs., Cape, 1887.
2	23 7 39·64	−27 55 18·8	Four obs., Cape, 1887.
3	23 22 44·60	−37 26 19·7	Four obs., Cape, 1887.
4	23 19 25·23	−44 5 52·8	Three obs., Cape, 1887, and one, 1890.

COMET, 1887 I.

This comet appeared as a pale narrow band of light, of nearly uniform brightness throughout its length. There was no head or condensation of any kind visible near the end; the light simply faded away to nothing. There was, however, a very slightly more condensed portion, extending over about half a degree, situated some way from the end.

The following rough observations were made by tracing the comet as far as possible with the finder of the 6-inch equatorial and reading the circles. The position of a star near the same part of the sky was observed each evening to eliminate index errors and refraction.

The resulting places are—

1887.		Cape Mean Time.	Observer.	Apparent R.A.	Apparent Dec.
		h m		h m s	° ′
January	22	8 50	F	21 30 0	−45 47½
	23	8 44	F	21 47 54	−46 32½
	24	8 50	F	22 8 15	−47 35
	*24	8 55	F	22 9 20	−47 54½
	25	9 4	F	22 30 44	−48 39
	27	8 58	F	23 16 10	−49 38
	*27	9 35	F	23 17 11	−49 50
	28	9 38	F	23 37 12	−49 22

The observations marked * are of the centre of the slightly brighter portion of the tail. Moonlight put a stop to any further observations for some time, and the comet could not be found again when the moon had drawn away from the evening sky.

Digitized by Google

COMET, 1887 IV. (BARNARD).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p Δ	Comet's Apparent Dec.	Log. p Δ	Star's Red. to App. Place.	Comp. Star.
1887.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
May 19	14 55 2·2	+0 51·20	+3 15·1	8–6	F	15 22 14·00	9·6271	−26 41 10·3	0·3508$_n$	+2·17 −1·4	1
21	8 13 33·1	+1 13·17	+1 6·3	16–12	F	15 25 19·68	9·6134$_n$	−25 34 28·8	0·3698$_n$	+2·16 −1·3	2
	8 21 37·2	+0 12·91		9–0	F	15 25 20·25	9·5973$_n$			+2·16	3
23	7 16 40·5	−0 34·28	−0 12·8	19–16	F	15 28 55·69	9·6764$_n$	−24 14 55·0	0·4820$_n$	+2·15 −1·0	4
24	7 48 49·3	+0 53·53	+5 1·8	24–12	F	15 30 50·39	9·6352$_n$	−23 32 8·0	0·4444$_n$	+2·15 −1·0	5
27	15 45 23·8	−0 56·33	+2 47·6	14–8	F	15 37 13·78	9·6856	−21 6 45·5	0·5518$_n$	+2·13 −0·5	6
June 8	6 27 13·8	+0 46·30	−2 6·5	12–8	F	16 1 34·58	9·6631$_n$	−12 1 41·8	0·6232$_n$	+2·07 +1·6	7
9	6 49 4·3	+0 40·11	+1 15·8	16–12	F	16 3 48·30	9·6400$_n$	−11 13 49·6	0·6152$_n$	+2·07 +1·9	8
11	7 22 10·8	−1 4·46	−3 54·3	16–12	F	16 8 16·86	9·5915$_n$	− 9 39 30·2	0·6104$_n$	+2·07 +2·4	9
13	6 25 38·0	−0 17·21	+0 46·1	16–12	F	16 12 39·25	9·6519$_n$	− 8 10 1·1	0·6456$_n$	+2·07 +2·9	10
14	7 14 30·1	+0 56·72	−0 19·2	14–12	F	16 14 58.20	9·5927$_n$	− 7 23 44·3	0·6326$_n$	+2·06 +3·1	11
16	7 32 2·1	−0 21·44	−5 47·0	16–16	F	16 19 29·44	9·5577$_n$	− 5 55 53·5	0·6406$_n$	+2·06 +3·7	12
17	13 26 57·1	−1 22·47	−0 18·6	22–12	F	16 22 16·69	9·5178	− 5 3 5·7	0·6449$_n$	+2·07 +4·0	13

Notes.

May 19. Comet is small and round, = star 10 mag.
21. Hazy sky: comet and stars faint.
23. The comet shows a nucleus equal to about 11 mag.
June 8. A nucleus equal to star of 11 mag. observable.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1887·0.	Dec. 1887·0.	Authority.
	h m s	° ′ ″	
1	15 21 20·63	−26 44 24·0	Three obs., Cape, 1887. C.G.A., 20,946.
2	15 24 4·35	−25 35 33·8	Two obs., Cape, 1887, and two, 1890.
3	15 25 5·18	−25 30 51·6	10½ mag. Equat. diff. from 2.
4	15 29 27·82	−24 14 41·2	Four obs., Cape, 1887.
5	15 29 54·71	−23 37 8·8	Three obs., Cape, 1887. C.G.A., 21,143.
6	15 38 7·98	−21 9 32·6	11 mag. Equat. diff. from *a*.
a	15 40 52·98	−21 10 47·1	Three obs., Cape, 1887.
7	16 0 46·21	−11 59 36·9	Four obs., Cape, 1887.
b	16 1 19·72	−11 15 35·1	Three obs., Cape, 1887.
8	16 3 6·12	−11 15 7·3	One obs., Cape. Equat. diff. from *b*.
9	16 9 19·25	− 9 35 38·3	Three obs., Cape, 1887.
10	16 12 54·39	− 8 10 50·1	Three obs., Cape, 1887.
11	16 13 59·42	− 7 23 28·2	Three obs., Cape, 1887.
12	16 19 48·82	− 5 50 10·2	Three obs., Cape, 1887.
13	16 23 37·09	− 5 2 51·1	Four obs., Cape, 1887.

Digitized by Google

COMET, 1888 I. (SAWERTHAL).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δα	Comet—Star. Δδ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p.\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1888.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Feb. 18	15 53 22·4	−0 31·97	+6 35·8	10–8	F	19 11 29·74	9·9380$_n$	−56 3 42·3	0·2525$_n$	−2·51 +10·7	1
	16 47 30·6	−3 24·49	+4 54·1	2–2	F	19 11 46·42	9·9084$_n$	−56 0 57·8	9·6158$_n$	−2·56 +10·4	2
19	15 21 39·0		−2 1·6	0–8	F			−54 50 55·4	0·4475$_n$	−2·47 +10·2	3
	15 37 46·7	+0 49·08		18–0	F	19 18 24·64	9·9286$_n$			−2·47 +10·2	3
	16 40 1·1		+2 2·8	0–4	F			−54 46 51·0	9·8916$_n$	−2·47 +10·2	3
	16 40 50·8	+4 49·40	−2 17·7	2–2	F	19 18 42·61	9·9016$_n$	−54 46 46·9	9·8774$_n$	−2·41 +10·5	4
20	15 43 32·3	+2 6·89	+2 3·0	18–16	F	19 25 4·42	9·9146$_n$	−53 33 18·3	0·3807$_n$	−2·37 + 9·7	5
21	15 59 29·8	−0 37·06	−1 2·7	12–12	F	19 31 27·68	9·8982$_n$	−52 13 59·1	0·3327$_n$	−2·35 + 9·0	6
22	15 54 26·5	+3 26·66	+1 23·6	12–12	F	19 37 26·73	9·8874$_n$	−50 54 4·0	0·3851$_n$	−2·25 + 8·7	7
26	15 42 32·6	+0 47·37	−0 57·1	17–12	F	19 58 54·85	9·8427$_n$	−45 18 38·3	0·5326$_n$	−2·04 + 6·3	8
27	15 55 26·2	+0 31·05	−2 35·4	20–16	F	20 3 48·27	9·8302$_n$	−43 50 41·0	0·4849$_n$	−1·99 + 5·8	9
29	16 52 10·9	+4 3·97	−1 41·5	4–4	F	20 13 8·80	9·7863$_n$	−40 49 44·8	0·3290$_n$	−1·88 + 4·9	10
March 2	16 11 26·7	−0 41·35	+1 25·2	14–12	F	20 21 35·95	9·7878$_n$	−37 51 40·6	0·5040$_n$	−1·80 + 3·9	11
	16 44 32·4	+2 5·75	−3 48·9	4–4	F	20 21 41·72	9·7733$_n$	−37 49 35·5	0·4084$_n$	−1·79 + 4·0	12
3	16 25 22·1	−0 11·94	−4 30·8	14–8	F	20 25 44·57	9·7741$_n$	−36 19 39·3	0·4818$_n$	−1·75 + 3·4	13
4	16 0 1·3	−0 30·78	+4 12·3	10–8	F	20 29 39·84	9·7736$_n$	−34 49 40·6	0·5566$_n$	−1·72 + 3·0	14
7	16 2 59·4	−3 43·36	−1 30·3	8–8	F	20 41 6·78	9·7506$_n$	−30 13 24·2	0·5809$_n$	−1·61 + 1·4	15
8	16 21 12·0	+2 8·25	+5 30·5	8–8	F	20 44 48·92	9·7393$_n$	−28 40 9·3	0·5625$_n$	−1·55 + 1·3	16
11	16 29 33·2	−2 55·50	−1 22·1	10–10	F	20 55 27·87	9·7171$_n$	−24 4 55·7	0·5765$_n$	−1·47 − 0·2	17
12	16 35 33·5	+1 0·58	+3 24·4	12–8	F	20 58 55·53	9·7087$_n$	−22 33 52·5	0·5777$_n$	−1·42 − 0·4	18
15	16 48 17·6	+1 35·69	−3 36·3	12–12	F	21 9 4·96	9·6865$_n$	−18 5 10·6	0·5921$_n$	−1·33 − 1·7	19
17	16 39 49·2	−0 41·45	+3 23·4	6–4	F	21 15 40·52	9·6863$_n$	−15 11 27·7	0·6208$_n$	−1·29 − 2·5	20

Notes.

Feb. 18. Star-like nucleus = 7 mag.
20. Tail 3° long.
Mar. 17. Position angle of tail 230°.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1880·0.	Dec. 1880·0.	Authority.
	h m s	° ′ ″	
1	19 12 4·22	−56 10 28·8	Two obs., Cape, 1888.
2	19 15 13·47	−56 6 2·3	Stone, 10,492. C.G.A., 26,499.
3	19 17 38·03	−54 49 4·0	Three obs., Cape, 1888.
4	19 13 55·62	−54 44 39·7	C.G.A., 26,468.
5	19 22 59·90	−53 35 31·0	C.G.A., 26,677.
6	19 32 7·09	−52 13 5·4	Three obs., Cape, 1888.
7	19 34 2·32	−50 55 36·3	C.G.A., 26,934.
8	19 58 9·52	−45 17 47·5	Two obs., Cape, 1888.
9	20 3 19·21	−43 48 11·4	C.G.A., 27,587.
10	20 9 6·71	−40 48 8·2	Three obs., Cape, 1888.
11	20 22 19·10	−37 53 9·7	Two obs., Cape, 1888.
12	20 19 37·76	−37 45 50·6	Stone, 10,915. C.G.A., 28,001.
13	20 25 58·26	−36 15 11·9	Two obs., Cape, 1888.
14	20 30 12·34	−34 53 55·9	C.G.A., 28,229.
15	20 44 51·75	−30 11 55·3	Stone, 11,087. C.G.A., 28,592.
16	20 42 42·22	−28 45 41·1	Two obs., Cape, 1888.
17	20 58 24·84	−24 3 33·4	C.G.A., 28,889.
18	20 57 56·37	−22 37 16·5	Three obs., Cape, 1888.
19	21 7 30·60	−18 1 32·6	Three obs., Cape, 1888.
20	21 16 23·26	−15 14 48·6	Three obs., Cape, 1888.

Digitized by Google

COMET, I. 1888 (SAWERTHAL).

OBSERVATIONS WITH 7½-INCH HELIOMETER.

Date.	Cape Mean Time.	Observer.	Distance.	Position Angle.	No. of Star.	Date.	Cape Mean Time.	Observer.	Distance.	Position Angle.	No. of Star.
1888.	h m s		″	° ′ ″		1888.	h m s		″	° ′ ″	
Feb. 20	16 8 15·5	G		123 34 19	1		16 55 2·9	G		182 2 56	6
	16 8 13·4	G	755·17		1		17 2 6·5	G		0 45 16	7
	16 27 28·0	G		225 32 58	2		17 8 19·0	G	4,452·40		7
	16 27 34·8	G	1,384·08		2		17 12 0·0	G	4,466·16		7
	16 37 31·8	G		114 38 37	1		17 16 3·5	G		1 6 43	7
	16 37 15·1	G	769·98		1	March 9	16 42 52·4	G		55 51 4	8
March 4	15 56 24·9	G		52 20 46	3		16 56 39·4	G	3,556·94		8
	16 5 42·5	G	1,688·01		3		17 0 9·6	G	3,571·08		8
	16 11 23·8	G	1,710·25		3		17 3 35·6	G		55 10 12	8
	16 16 2·2	G		51 9 58	3		17 14 49·8	G		224 9 32	9
	16 25 49·4	G		199 32 29	4		17 18 31·1	G	1,784·61		9
	16 31 13·3	G	956·80		4		17 21 54·3	G		224 26 41	9
	16 36 4·9	G	936·66		4	March 11	16 8 7·9	G		80 28 35	10
	16 41 25·6	G		198 57 8	4		16 26 26·2	G	3,951·65		10
March 8	16 12 43·1	G		182 6 44	5		16 30 28·1	G	3,961·85		10
	16 19 2·5	G	931·97		5		16 34 52·1	G		79 38 33	10
	16 22 51·7	G	917·28		5		16 44 50·9	G		247 50 26	11
	16 27 1·0	G		180 29 43	5		16 49 48·1	G	4,454·99		11
	16 36 28·9	G		182 26 4	6		16 54 17·7	G	4,440·44		11
	16 42 14·7	G	4,719·25		6		16 59 29·3	G		248 21 53	11
	16 49 22·2	G	4,692·33		6						

The above results are corrected for refraction and approximate index error of position circle. They were then compared with the distances and position angles computed from an ephemeris forwarded by Dr. Kreutz.

The resulting equations are :—

Feb. 20.	Distances.			o—c	Position Angles.				″
+0·498Δα	−0·547Δδ	−0·75Δν	=	+2″·69	−89·20Δα	−229·48Δδ	−Δp	=	+ 1530
−0·426	−0·699	−1·38	=	+3·76	−62·33	+106·75	−Δp	=	− 241
+0·542	−0·414	−0·77	=	+1·15	−65·96	−244·24	−Δp	=	+ 883
March 4.	**Distances.**				**Position Angles.**				
+0·644Δα	+0·618Δδ	−1·69Δν	=	−2″·26	+ 62·36Δα	−98·83Δδ	−Δp	=	−209
+0·641	+0·622	−1·71	=	−2·41	+ 61·08	−92·92	−Δp	=	−304
−0·271	−0·944	−0·95	=	+2·89	−163·79	+70·19	−Δp	=	+459
−0·268	−0·945	−0·93	=	+3·56	−176·43	+73·00	−Δp	=	+572
March 8.	**Distances.**				**Position Angles.**				
−0·019Δα	−0·998Δδ	−0·93Δν	=	−1″·25	−189·07Δα	+7·41Δδ	−Δp	=	+508
−0·012	−1·000	−0·92	=	−1·21	−200·75	+1·17	−Δp	=	+729
−0·035	−0·999	−4·72	=	−1·19	− 38·37	+1·83	−Δp	=	+ 98
−0·033	−0·999	−4·69	=	−0·39	− 38·97	+1·53	−Δp	=	+215
+0·015	+1·000	−4·45	=	+0·96	+ 40·64	−0·67	−Δp	=	−260
+0·016	+1·000	−4·47	=	+0·58	+ 40·16	−0·94	−Δp	=	−197

Digitized by Google

March 9.	Distances.			o—c		Position Angles.			
				″					″
+0·7311Δα	+0·567Δδ	−3·56Δν	=	−3·07	+29·25Δα	−48·71Δδ	−Δp	=	−244
+0·730	+0·569	−3·57	=	−2·11	+29·12	−47·25	−Δp	=	−261
−0·622	−0·717	−1·78	=	+0·76	−73·48	+79·75	−Δp	=	+333
					−74·32	+81·45	−Δp	=	+336

March 11.	Distances.					Position Angles.			
				″					″
+0·899Δα	+0·172Δδ	−3·96Δν	=	−4·13	+ 7·88Δα	−51·71Δδ	−Δp	=	−126
+0·898	+0·175	−3·97	=	−5·32	+ 8·46	−51·01	−Δp	=	−191
−0·848	−0·374	−4·45	=	+2·31	−15·93	+42·74	−Δp	=	+ 66
−0·849	−0.372	−4·44	=	+1·54	−15·75	+43·35	−Δp	=	+ 65

Δν is the correction to the scale-value for a distance of 1,000″, and Δp is the correction to the assumed index error of the position circle.

Multiplying the Position-Angle Equations by $\frac{\Delta}{206{,}265}$ and solving for each day, we get—

Date.	Cape Mean Time.			Δ α	Δ δ	Δ ν	Δ p
	h	m	s	″	″	″	″
Feb. 20	16	24	23·1	− 1·07	− 4·55		
Mar. 4	16	20	30·8	− 4·34	− 1·41	− 0·78	+ 2·10
8	16	45	16·3	− 4·32	+ 1·02	+ 0·02	+ 0·59
9	17	5	30·3	− 1·94	− 0·15	+ 0·31	− 3·34
11	16	38	32·5	− 3·34	− 1·83	+ 0·36	− 1·53

The means of the values of Δν and Δp found on Mar. 8, 9 and 11 have been substituted in the equations for Feb. 20.

Applying the above corrections to the positions given in Dr. Kreutz's ephemeris, we get for the position of the comet—

Berlin Mean Time.		R.A.			Dec.		
		h	m	s	°	′	″
Feb.	20·5	19	24	10·60	−53	43	52·6
Mar.	4·5	20	29	4·26	−35	3	16·5
	8·5	20	44	13·07	−28	55	8·4
	9·5	20	46	1·88	−27	23	13·7
	11·5	20	54	52·48	−24	20	18·8

COMET, 1888 I. (SAWERTHAL).

ADOPTED MEAN PLACES OF STARS FOR OBSERVATIONS WITH THE HELIOMETER.

Star.	R.A. 1888·0.			Dec. 1888·0.			Star's Red. to App. Place.		Authority.
	h	m	s	°	′	″	s	″	
1	19	24	3·05	−53	25	13·1	−2·37	+9·6	Four Cape obs., 1888.
2	19	27	9·10	−53	14	57·1	−2·39	+9·4	Four Cape obs., 1888.
3	20	27	54·68	−35	6	45·9	−1·71	+3·2	Four Cape obs., 1888.
4	20	30	12·43	−34	32	43·6	−1·71	+2·9	Four Cape obs., 1888.
5	20	44	52·05	−28	24	47·5	−1·55	+1·1	Three Cape obs., 1888.
6	20	45	8·14	−27	20	15·0	−1·53	+0·9	ωCapricorni, Stone and Gould.
7	20	44	52·14	−29	51	23·8	−1·58	+1·5	Three Cape obs., 1888.
8	20	44	51·63	−27	39	41·8	−1·51	+1·1	Cordoba Gen. Cat., 28,593.
9	20	50	8·03	−26	43	21·2	−1·52	+0·6	Four Cape obs., 1888.
10	20	50	44·39	−24	16	29·3	−1·44	+0·2	Four Cape obs., 1888.
11	21	0	33·50	−23	35	52·2	−1·47	−0·4	Four Cape obs., 1888.

Digitized by Google

COMET, 1888 II. (ENCKE).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. p	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1888.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Aug. 3	7 24 50·0	−0 28·08	−0 16·8	12–12	F	12 12 53·96	9·6514	−17 27 53·0	0·5572$_n$	+0·28 −5·6	1
4	7 13 18·6	−1 4·43	−2 48·0	12–12	F	12 21 22·60	9·6355	−18 28 31·6	0·5292$_n$	+0·30 −5·8	2
5	7 35 41·1	−0 38·25	−1 49·9	12–12	F	12 30 2·28	9·6576	−19 28 16·1	0·5372$_n$	+0·35 −5·9	3
6	7 11 13·2		+4 22·6	0–4	F			−20 23 53·5	0·4916$_n$	+0·38 −6·0	4
	7 20 14·8	−0 47·12		8–0	F	12 38 25·65	9·6380			+0·38 −6·0	4
9	7 49 1·5	−0 34·42	+2 39·1	12–16	F	13 3 44·32	9·5918	−22 59 6·9	0·4896$_n$	+0·50 −6·3	5

Notes.

Aug. 6. Comet very faint.
9. Comet exceedingly faint, and very difficult.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1888·0.	Dec. 1888·0.	Authority.
	h m s	° ′ ″	
1	12 13 21·76	−17 27 30·6	Three obs., Cape, 1889.
2	12 22 26·73	−18 25 37·8	Three obs., Cape, 1889.
3	12 30 40·18	−19 26 20·3	Four obs., Cape, 1889.
4	12 39 12·39	−20 28 10·1	Two obs., Cape, 1889.
5	13 4 18·24	−23 1 39·7	Three obs., Cape, 1889.

COMET, 1889 IV. (DAVIDSON).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1889.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 25	8 17 23·9	−1 33·07	+2 32·4	10–8	F	13 14 25·19	9·6186	−25 58 42·9	0·3678$_n$	+0·58 −8·7	1
26	8 16 29·6	+1 3·48	−2 46·3	16–16	F	13 25 28·74	9·5936	−23 7 25·2	9·4089$_n$	+0·62 −7·6	2
27	8 13 28·1	−2 7·11	+0 31·8	12–12	F	13 35 53·30	9·5675	−20 16 53·0	0·4481$_n$	+0·68 −6·4	3
29	7 47 14·9	+1 5·94	+2 27·1	12–12	F	13 54 46·40	9·4714	−14 46 30·5	0·5088$_n$	+0·73 −4·1	4
Aug. 1	8 11 47·8	−0 16·13	+2 11·1	18–12	F	14 19 24·69	9·4893	− 7 4 16·0	0·6199$_n$	+0·82 −0·8	5
12	6 59 18·7	+1 12·14	−2 20·6	10–8	F	15 19 49·59	9·1466	+11 57 19·9	0·7971$_n$	+0·89 +7·3	6
14	8 37 46·1	+0 15·66	+0 35·7	16–8	F	15 27 54·42	9·5197	+14 15 13·2	0·7875$_n$	+0·89 +8·3	7

Notes.

July 21. The comet has a bright round nucleus, about = star 8 mag. in brightness, and is surrounded by faint nebulous matter, with a short tail.
27. Fairly sharp nucleus: would have been just observable in a field sufficiently bright to show the wires. Definition good and steady. Faint tail.
Aug. 12. Decidedly fainter, but nucleus still fairly bright and small = star 9½ mag.

Digitized by Google

COMET, 1889 IV. (DAVIDSON).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1889·0.	Dec. 1889·0.	Authority.
	h m s	° ′ ″	
1	13 15 57·68	−26 1 6·6	Five obs., Cape, 1890.
2	13 24 24·64	−23 4 31·3	Three obs., Cape, 1890.
3	13 37 59·73	−20 17 18·4	Three obs., Cape, 1890.
4	13 53 39·73	−14 48 53·5	Four obs., Cape, 1890.
5	14 19 40·00	− 7 6 26·3	Three obs., Cape, 1890.
6	15 18 36·56	+11 59 33·2	Four obs., Cape, 1890.
7	15 27 37·87	+14 14 29·2	Three obs., Cape, 1890.

COMET, 1891 I. (BARNARD–DENNING).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. place.	Comp. Star.
1891.	h m s	m s	′ ″			h m s		° ′ ″			
June 9	6 19 18·9		−3 4·1	4	F			−41 53 33·3	0·5523$_n$	+1·3	1
9	6 24 45·5	−2 40·35		6	F	5 37 34·28	9·8184			−1·57	1
14	6 25 26·8		−2 34·3	7	F			−45 20 16·8	0·4319$_n$	−0·9	2
14	6 31 29·6	−1 33·96		8	F	6 28 28·74	9·8403			−1·67	2
15	6 24 2·7		+3 5·0	4	F			−45 49 50·0	0·3992$_n$	−1·6	3
15	6 39 39·4	−3 49·18		4	F	6 38 49·58	9·8448			−1·68	3

Notes.

June 9. Comet faint; slightly more condensed towards the centre, round, about 1½′ in diameter.
14, 15. Moonlight; comet very faint and difficult.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1891·0.	Dec. 1891·0.	Authority.
	h m s	° ′ ″	
1	5 40 16·20	−41 50 30·5	Equatorial comp. with *a*. 9 mag. (C.Z.V. 1480.)
a	5 41 39·72	−41 49 34·9	C.G.A., 6,775.
2	6 30 4·37	−45 17 41·6	C.G.A., 8,059.
3	6 42 40·44	−45 52 53·4	Equatorial comp. with *b* and *c*. 9½ mag.
b	6 49 15·70	−45 54 56·0	C.Z. VI. 2,450.
c	6 51 27·58	−45 45 15·6	C.G.A., 8,686.

Digitized by Google

COMET, 1891 IV. (BARNARD).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star.		No. of Comp.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.
		$\Delta\alpha$	$\Delta\delta$						
1891.	h m s	m s	′ ″	α δ	h m s		° ′ ″		s ″
Oct. 9	15 16 18·5	−1 50·94	−1 50·6	8–4	8 12 17·68	9·7052$_n$	−37 9 46·6	0·1482$_n$	+0·48 +16·4

Note.

Comet round, $\frac{3}{4}'$ in diameter, rather faint, very slightly more condensed towards middle.

ADOPTED MEAN PLACE OF COMPARISON STAR.

Star.	R.A. 1891·0.	Dec. 1891·0.	Authority.
	h m s	° ′ ″	
	8 14 8·14	−37 8 12·4	C.G.A., and equatorial comp. with a.
a	8 15 41·88	−37 4 28·4	Cape, 1880. 428o.

COMET, 1892 I. (SWIFT).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star.		No. of Comp.	Ob-server.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
		$\Delta\alpha$	$\Delta\delta$								
1892.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Mar. 8	16 58 31·8	−1 16·42	−1 54·8	6–6	F	19 6 27·87	9·5999$_n$	−30 2 53·6	0·2133$_n$	−0·87 − 5·2	1
9	15 31 24·5		−3 26·6	0–2	F			−29 16 32·6	0·4531$_n$	− 5·5	2
9	15 41 22·4	−1 34·78		8–0	F	19 11 3·04	9·7039$_n$			−0·82	2
10	15 50 13·3	+1 3·35	+0 20·5	8–8	F	19 15 53·40	9·6927$_n$	−28 25 26·0	0·4295$_n$	−0·83 − 5·7	3
11	15 42 1·5	−2 41·44	+0 14·5	8–8	F	19 20 37·68	9·6978$_n$	−27 34 1·5	0·4635$_n$	−0·83 − 6·0	4
16	15 55 44·4	+2 49·93	+5 21·8	10–8	F	19 43 51·63	9·6716$_n$	−22 59 13·4	0·5024$_n$	−0·74 − 7·3	5
19	14 54 33·7		+3 4·9	0–2	F			−20 6 9·7	0·6094$_n$	− 8·1	6
19	15 3 58·0	+2 54·25		2–0	F	19 57 6·79	9·7028$_n$			−0·70	6
20	15 32 48·9	−0 23·36	+2 34·1	10–20	F	20 1 34·59	9·6822$_n$	−19 4 30·5	0·5737$_n$	−0·71 − 8·4	7
21	15 56 2·1	−1 47·96	−2 39·8	16–12	F	20 5 59·17	9·6607$_n$	−18 2 52·4	0·5597$_n$	−0·71 − 8·7	8
23	15 46 25·6	−1 35·87	−1 56·6	12–12	F	20 14 30·75	9·6647$_n$	−16 0 11·2	0·5879$_n$	−0·69 − 9·1	9
26	16 3 0·6		−2 24·8	0–8	F			−12 51 33·6	0·6017$_n$	− 9·8	10
26	16 15 58·8	−1 35·78		12–0	F	20 27 7·17	9·6285$_n$			−0·66	10
29	16 3 52·0		−0 56·0	0–10	F			− 9 41 19·5	0·6275$_n$	−10·5	11
29	16 31 48·7	+0 24·18		6–0	F	20 39 19·82	9·6038$_n$			−0·63	11
30	16 2 22·1		−1 22·0	0–4	F			− 8 37 48·5	0·6365$_n$	−0·63 −10·6	12
Apr. 1	16 16 55·3	+1 23·73	−3 5·9	12–12	F	20 51 6·71	9·6197$_n$	− 6 30 2·9	0·6472$_n$	−0·61 −11·1	13
3	16 5 21·9	+0 47·77	−3 46·9	12–12	F	20 58 47·26	9·6311$_n$	− 4 24 1·7	0·6649$_n$	−0·61 −11·4	14

Digitized by Google

COMET, 1892 I. (SWIFT).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1892·0.	Dec. 1892·0.	Authority.
	h m s	° ′ ″	
1	19 7 45·16	−30 0 53·6	Three obs., Cape, 1894.
2	19 12 38·64	−29 13 0·5	Three obs., Cape, 1894.
3	19 14 50·88	−28 25 40·8	Three obs., Cape, 1894.
4	19 23 19·95	−27 34 10·0	Three obs., Cape, 1894.
5	19 41 2·44	−23 4 27·9	Three obs., Cape, 1894.
6	19 54 13·24	−20 9 6·5	Three obs., Cape, 1894.
7	20 1 58·66	−19 6 56·3	Four obs., Cape, 1894.
8	20 7 47·84	−18 0 4·0	Three obs., Cape, 1894.
9	20 16 7·31	−15 58 5·5	Three obs., Cape, 1894.
10	20 28 43·61	−12 48 58·9	Three obs., Cape, 1894.
11	20 38 56·27	− 9 40 13·0	Three obs., Cape, 1894.
12	20 44 34·95	− 8 36 15·9	One obs., Cape, 1894.
13	20 49 43·59	− 6 26 46·0	Three obs., Cape, 1894.
14	20 58 0·10	− 4 20 3·4	Three obs., Cape, 1894.

COMET, 1892 VI. (BROOKS).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1893.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
Jan. 16	14 59 51·2	−1 25·21	+2 55·8	9–8	F	15 42 43·20	9·8014$_n$	−41 55 33·1	0·3625$_n$	−1·66 +4·1	1
18	15 3 20·9	−3 9·37	+0 54·1	6–6	F	15 52 3·63	9·8005$_n$	−42 4 29·7	0·3477$_n$	−1·63 +3·4	2
23	14 46 55·9	−0 49·06	+1 8·1	12–12	F	16 14 9·50	9·8113$_n$	−42 14 27·1	0·4190$_n$	−1·54 +2·2	3
24	14 49 26·6	−1 17·78	−1 8·7	12–12	F	16 18 23·35	9·8104$_n$	−42 14 35·0	0·4110$_n$	−1·53 +1·9	4
28	14 56 34·5	−2 16·48	+1 39·3	12–8	F	16 34 36·55	9·8068$_n$	−42 9 42·9	0·3883$_n$	−1·45 +0·9	5
30	14 46 35·9	−0 45·17	+3 45·8	12–9	F	16 42 15·92	9·8107$_n$	−42 4 26·2	0·4237$_n$	−1·39 +0·5	6
Feb. 16	14 59 48·4	+2 0·64	−4 0·4	12–8	F	17 36 44·90	9·7872$_n$	−40 28 25·1	0·3547$_n$	−0·93 −2·2	7
18	14 52 55·5	+1 11·91	−1 54·0	12–8	F	17 41 55·59	9·7883$_n$	−40 13 18·0	0·3740$_n$	−0·87 −2·4	8
19	14 44 59·2	+1 43·91	−2 15·7	12–8	F	17 44 25·11	9·7902$_n$	−40 5 35·9	0·3993$_n$	−0·84 −2·5	9
20	14 52 8·7	−2 29·21	−2 44·9	12–8	F	17 46 52·26	9·7848$_n$	−39 57 41·3	0·3701$_n$	−0·83 −2·7	10
21	14 44 7·8	−0 42·47	−0 12·2	12–8	F	17 49 14·62	9·7876$_n$	−39 49 46·6	0·3964$_n$	−0·79 −2·7	11
22	14 44 15·4	−1 30·56	−2 9·8	12–8	F	17 51 34·06	9·7859$_n$	−39 41 42·3	0·3915$_n$	−0·77 −2·8	12
Mar. 16	14 54 19·8	−1 49·96	−1 45·2	11–8	F	18 28 50·70	9·7188$_n$	−36 35 1·6	0·2251$_n$	−0·09 −3·8	13
17	14 50 10·4	+3 13·46	+1 1·3	12–8	F	18 29 56·14	9·7190$_n$	−36 26 33·6	0·2358$_n$	−0·03 −3·8	14
18	14 41 40·0	−1 8·35	+1 10·5	12–8	F	18 31 40·16	9·2745$_n$	−36 20 43·3	0·2610$_n$	−0·02 −3·8	15
22	14 54 54·0	−2 29·68	+0 30·3	12–8	F	18 34 39·76	9·6894$_n$	−35 44 20·7	0·1691$_n$	+0·11 −3·9	16
25	14 49 42·0	+1 31·33	−4 0·0	12–8	F	18 36 53·86	9·6810$_n$	−35 19 22·2	0·1635$_n$	+0·23 −4·0	17
26	14 52 11·6	+2 10·06	+4 16·6	12–8	F	18 37 32·62	9·6719$_n$	−35 11 5·6	0·1418$_n$	+0·26 −4·0	17
April 14	14 8 36·1	+0 31·84	−0 53·3	12–8	F	18 40 47·44	9·6134$_n$	−32 39 4·3	0·1225$_n$	+0·91 −4·2	18
17	14 16 33·4	+0 42·38	+2 53·8	12–8	F	18 39 45·21	9·5657$_n$	−32 15 26·5	0·0500$_n$	+1·03 −4·3	19
20	13 45 48·2	−0 25·09	−3 16·3	12–8	F	18 38 19·57	9·5999$_n$	−31 52 7·2	0·1329$_n$	+1·14 −4·5	20
23	13 10 50·3	−1 12·27	+1 46·6	12–8	F	18 36 31·90	9·6383$_n$	−31 28 42·4	0·2253$_n$	+1·24 −4·5	21

Notes.

Jan. 16, 18. Very bad definition; comet very diffused.
Feb. 19, Mar. 17. Comet bears as bright a wire in observing as a 10 mag. star.
April 14. Comet faint; a small star near it was troublesome.
23. Comet near two small stars; faint and difficult.

Digitized by Google

COMET, 1892 VI. (BROOKS).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1893·0.	Dec. 1893·0.	Authority.
	h m s	° ′ ″	
1	15 44 10·07	−41 58 33·0	Three obs., Cape, 1893.
2	15 55 14·63	−42 5 27·3	Three obs., Cape, 1893.
a	16 11 15·86	−42 24 40·5	Cape, 1880, and C.G.A.
3	16 15 0·10	−42 15 37·4	Equatorial diff. from *a*.
4	16 19 42·66	−42 13 28·2	Three obs., Cape, 1893.
5	16 36 54·48	−42 11 23·1	Three obs., Cape, 1893.
6	16 43 2·48	−42 8 12·5	Equatorial comp. with *b*. $9\frac{1}{2}$ mag.
b	16 46 26·78	−42 11 0·1	Cape, 1885. Cape, 1880. C.G.A.
7	17 34 45·19	−40 24 22·6	Three obs., Cape, 1893.
c	17 40 6·10	−40 5 5·4	Cape, 1885. C.G.A.
8	17 40 44·55	−40 11 21·6	Equatorial comp. with *c*. $9\frac{1}{2}$ mag.
9	17 42 42·04	−40 3 17·8	Four obs., Cape, 1894.
10	17 49 22·30	−39 54 53·7	Four obs., Cape, 1893.
11	17 49 57·88	−39 49 31·7	Three obs., Cape, 1893.
12	17 53 5·39	−39 39 29·7	Three obs., Cape, 1893.
13	18 30 40·75	−36 33 12·6	Equatorial comp. with *d*. $9\frac{3}{4}$ mag.
d	18 32 58·73	−36 36 27·7	Three obs., Cape, 1893.
14	18 26 42·71	−36 27 31·1	Three obs., Cape, 1893.
15	18 32 48·53	−36 21 50·0	Three obs., Cape, 1893.
16	18 37 9·33	−35 44 47·2	Three obs., Cape, 1893.
17	18 35 22·30	−35 15 18·3	Three obs., Cape, 1893.
18	18 40 14·69	−32 38 6·7	Equatorial comp. with *e*. $9\frac{1}{2}$ mag.
e	18 40 39·79	−32 40 34·7	Three obs., Cape, 1893.
19	18 39 1·80	−32 18 15·9	Three obs., Cape, 1893.
20	18 38 43·52	−31 48 46·4	Equatorial comp. with *f*. $9\frac{1}{2}$ mag.
f	18 40 15·92	−31 51 12·0	Three obs., Cape, 1893.
21	18 37 42·93	−31 30 24·5	Three obs., Cape, 1894.

COMET, 1893 II.

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\Delta$	Comet's Apparent Dec.	Log. $p\Delta$	Star's Red. to App. Place.	Comp. Star.
1893.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
July 23	6 38 3·6	−1 42·73	+0 37·2	6–4	F	11 36 4·23	9·5917	+23 9 11·5	0·8116$_n$	+0·82 + 2·1	1
25	6 34 2·5	+0 30·99	−4 1·2	12–8	F	11 43 51·85	9·5784	+21 1 58·9	0·8070$_n$	+0·81 + 1·5	2
26	6 44 29·2	−2 1·58	+4 15·6	12–8	F	11 47 7·50	9·5949	+20 5 42·3	0·7973$_n$	+0·82 + 1·1	3
27	6 33 18·9	+1 10·19	+1 35·0	11–8	F		9·5752		0·7998$_n$	+0·80 + 0·9	4
Aug. 2	6 40 31·9	+1 31·24	+0 43·3	12–8	F		9·5974		0·7747$_n$	+0·79 − 0·5	5
3	6 33 48·5	+0 29·94	+5 53·6	12–8	F	12 3 28·52	9·5896	+14 46 1·9	0·7745$_n$	+0·79 − 0·7	6
4	6 35 53·4	−1 0·71	+6 52·5	12–8	F	12 4 47·64	9·5958	+14 15 46·4	0·7705$_n$	+0·79 − 0·9	7
5	6 34 17·1	−0 35 50	−3 49·9	12–8	F		9·5968		0·7680$_n$	+0·78 − 1·0	8
6	6 38 37·5	−0 15·76	−7 46·9	12–8	F		9·6063		0·7629$_n$	+0·78 − 1·1	9
11	6 47 17·0	+1 33·27	+3 15·0	6–4	F	12 11 49·12	9·6334	+11 30 57·2	0·7453$_n$	+0·74 − 1·7	10
12	6 34 44·4	−1 4·51	+0 46·6	12–8	F		9·6218		0·7481$_n$	+0·75 − 1·9	11
13	6 46 19·9	+1 0·63	+1 57·1	12–8	F		9·6383		0·7408$_n$	+0·74 − 2·0	12
14	6 30 52·5	−0 10·45	−1 11·3	12–8	F	12 14 4·18	9·6240	+10 35 56·2	0·7447$_n$	+0·74 − 2·1	13
16	6 35 10·4		−0 41·7	0–4	F				0·7382$_n$	− 2·3	14
16	6 43 28·2	+1 27·68		6–0	F		9·6442			+0·72	14

Notes.

July 23. Bright and round; stars very unsteady. Moonlight; no trace of tail.
Aug. 2. Comet decidedly fainter.
6. Definition very bad; scarcely possible to observe the star at times.

Digitized by Google

COMET, 1893 II.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1893·0.	Dec. 1893·0.	Authority.
	h m s	° ′ ″	
1	11 37 46·14	+23 8 32·2	Equatorial comp. from *a*.
a	11 39 29·01	+23 6 15·9	C.G.A., 4352.
2	11 43 20·05	+21 5 58·6	C.G.A, 4370, and equatorial comp. from *b*.
b	11 47 0·52	+21 0 15·3	C.G.A., 4381.
3	11 49 8·26	+20 1 25·6	C.G.A., 4394.
4			B.D. + 19°, 2515.
5			B.D. + 15°, 2410.
6	12 2 57·79	+14 40 9·0	Equatorial comp. from *c*.
c	12 6 29·24	+14 37 47·5	W.B., XII., 92.
7	12 5 47·56	+14 8 54·8	Schj., 4397, and Glasg., 3115.
8			B.D. + 14°, 2481.
9			B.D. + 13°, 2505.
10	12 10 15·11	+11 27 43·9	Schj., 4428.
11			B.D. + 11°, 2448.
12			B.D. + 11°, 2444.
13	12 14 13·89	+10 37 9·6	Equatorial comp. from *d*.
d	12 14 41·86	+10 29 9·4	Glasg., 3149.
14			W.B., XII., 185.

The comparison stars for this comet, being considerably north of the equator, were not observed on the meridian at the Cape. It was thought that their places would most probably be re-determined at some northern observatory.

COMET, 1893 III. (FINLAY, 1886 VII.).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1893.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
May 18	16 15 39·0	−0 7·41	+1 31·7	8–8	F	23 42 1·97	9·6030$_n$	− 5 1 51·1	0·6551$_n$	+0·11 +0·8	1
21	16 47 38·9	−1 28·59		12–0	F	23 54 51·96	9·5538$_n$			+0·11	2
21	16 31 27·8		−3 18·8	0–4	F			− 3 40 40·6	0·6631$_n$	+1·4	2
23	16 49 21·3	−0 49·58	+1 3·1	13–8	F	0 3 29·07	9·5518$_n$	− 2 45 2·0	0·6688$_n$	+0·12 +1·8	3
26	16 32 12·6	−0 33·44	−0 41·0	12–8	F	0 16 31·61	9·5819$_n$	− 1 20 46·8	0·6807$_n$	+0·12 +2·3	4
26	17 20 13·3	−0 24·88	+0 16·3	6–4	F	0 16 40·17	9·4906$_n$	− 1 19 49·5	0·6791$_n$	+0·12 +2·3	4
27	17 11 35·8	+2 38·16	−0 13·5	12–8	F	0 21 3·39	9·5111$_n$	− 0 51 22·0	0·6835$_n$	+0·14 +2·4	5
June 18	17 29 49·7	+0 50·52	−3 37·6	12–8	F	2 2 37·02	9·5097$_n$	+ 9 43 29·0	0·7623$_n$	+0·20 +6·2	6
19	17 13 13·5	−0 51·56	−6 53·9	12–8	F	2 7 18·28	9·5466$_n$	+10 10 21·9	0·7600$_n$	+0·20 +6·4	7
24	16 58 29·4	−0 16·72	−5 27·0	12–8	F	2 31 0·39	9·5822$_n$	+12 20 58·3	0·7647$_n$	+0·23 +7·0	8
24	17 22 2·4	−0 12·17	−5 3·5	6–4	F	2 31 4·94	9·5400$_n$	+12 21 21·8	0·7734$_n$	+0·23 +7·0	8
July 11	17 33 5·3	+2 7·12	+7 49·8	12–8	F	3 51 3·83	9·5563$_n$	+18 24 29·1	0·8010$_n$	+0·41 +8·8	9
12	17 18 23·7	−0 19·08	+1 35·4	19–12	F	3 55 36·77	9·5847$_n$	+18 41 7·8	0·7943$_n$	+0·42 +8·8	10
14	17 9 54·0	+1 47·03	−6 43·9	12–8	F	4 4 43·38	9·6023$_n$	+19 12 58·2	0·7909$_n$	+0·45 +8·9	11
14	17 38 21·3	+1 52·71	−6 24·5	6–4	F	4 4 49·06	9·5519$_n$	+19 13 17·6	0·8060$_n$	+0·45 +8·9	11
15	17 20 29·4	−1 29·54	+3 19·4	18–12	F	4 9 17·87	9·5868$_n$	+19 28 13·6	0·7972$_n$	+0·46 +9·0	12
16	17 20 2·4	+0 33·43	+1 25·9	16–12	F	4 13 48·84	9·5892$_n$	+19 42 50·7	0·7976$_n$	+0·47 +9·0	13
23	17 35 28·8	+2 28·29	+2 50·2	12–8	F	4 44 51·34	9·5718$_n$	+21 10 33·3	0·8096$_n$	+0·58 +9·2	14
25	17 32 55·9	+0 49·40	−3 40·4	12–8	F	4 52 29·01	9·5786$_n$	+21 30 55·1	0·8091$_n$	+0·61 +9·2	15

Notes.

May 18. The proximity of the comparison star made the comet exceedingly faint. It was almost impossible to see the wire and the comet at the same time. The comet is a faint round nebulosity of about 1′ diameter.

21. Clouded after observations for Δ *a*.

June 24. Very clear morning. Comet much brighter than at any previous observation; it bears about as bright illumination of the wire as a star of 10½ mag. It is about ½′ in diameter, but shows no well-marked condensation.

July 15. Comet low down at first and faint.

16. Comet faint.

25. Comet very faint. Air very damp: fogged up completely after observations.

Digitized by Google

COMET, 1893 III. (FINLAY, 1886, VII.).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1893·0.	Dec. 1893·0.	Authority.
	h m s	° ′ ″	
1	23 42 9·27	− 5 3 23·6	Three obs., Cape, 1893.
2	23 56 20·44	− 3 37 23·2	Three obs., Cape, 1893.
a	0 3 14·16	− 2 49 6·1	Three obs., Cape, 1893.
3	0 4 18·53	− 2 46 6·9	Equatorial comp. with *a*. 9½ mag.
4	0 17 4·93	− 1 20 8·2	Equatorial comp. with *b*. 10½ mag.
b	0 20 15·88	− 1 20 34·5	Three obs., Cape, 1893.
5	0 18 25·09	− 0 51 11·0	Four obs., Cape, 1893.
6	2 1 46·30	+ 9 47 0·5	Equatorial comp. with *c*. 10 mag.
c	2 6 47·62	+ 9 49 33·4	Four obs., Cape, 1893.
7	2 8 9·64	+10 17 9·5	Equatorial comp. with *d*. 9½ mag.
d	2 9 58·57	+10 16 28·4	Four obs., Cape, 1893.
8	2 31 16·88	+12 26 18·3	Three obs., Cape, 1893.
9	3 48 56·30	+18 16 30·6	Three obs., Cape, 1893.
e	3 51 38·93	+18 37 28·3	Two obs., Cape, 1893, and equatorial comp. with *f*.
f	3 50 51·68	+18 31 43·5	Two obs., Cape, 1893.
10	3 55 55·43	+18 39 23·6	Equatorial comp. with *e*. 9¼ mag.
11	4 2 55·89	+19 19 33·3	Four obs., Cape, 1893.
12	4 10 46·95	+19 24 45·2	Three obs., Cape, 1893.
13	4 13 14·94	+19 41 15·8	Three obs., Cape, 1893.
14	4 42 22·47	+21 7 33·9	Three obs., Cape, 1893.
15	4 51 39·00	+21 34 26·3	Three obs., Cape, 1893.

COMET, 1894 II. (GALE).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ α	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. $p\,\Delta$	Comet's Apparent Dec.	Log. $p\,\Delta$	Star's Red. to App. Place.	Comp. Star.
1894.	h m s	m s	′ ″	α δ		h m s		° ′ ″		s ″	
April 11	7 16 46·1	−0 55·79	−5 7·0	4–4	F	3 30 27·26	9·9194	−54 57 5·4	0·1513$_n$	−1·07 −1·9	1
12	7 46 7·1	−1 47·19	−3 42·0	12–8	F	3 40 3·57	9·9243	−54 40 11·8	0·3281$_n$	−1·07 −2·1	2
13	7 22 27·2	−0 29·64	+5 35·2	8–8	F	3 49 51·57	9·9095	−54 19 38·4	0·1202$_n$	−1·07 −2·4	3
17	7 7 5·3	−0 54·83	−2 42·3	8–8	F	4 35 30·84	9·8529	−51 55 36·3	9·6544$_n$	−0·99 −3·6	4
23	7 2 53·5	−0 30·02	+0 6·4	12–8	F	5 59 19·05	9·6949	−43 1 25·3	9·3078$_n$	−0·60 −6·4	5
24	8 4 59·6	+1 46·38	−0 8·2	12–8	F	6 14 51·16	9·7481	−40 30 12·6	0·1391$_n$	−0·51 −6·6	6
25	7 43 58·5	−2 24·24	−2 13·2	12–8	F	6 29 29·90	9.6913	−37 48 33·7	0·0464$_n$	−0·39 −7·0	7
26	8 32 43·6	+1 15·18	−1 12·3	12–8	F	6 44 43·78	9·7199	−34 39 15·3	0·3157$_n$	−0·29 −7·0	8
27	7 41 7·7	−2 16·16	−3 10·8	12–8	F	6 58 41·48	9·6184	−31 25 15·5	0·1922$_n$	−0·17 −7·1	9
28	7 40 56·1	−1 51·54	−2 2·6	12–8	F	7 12 50·47	9·5831	−27 47 48·9	0·2736$_n$	−0·06 −6·9	10
30	7 42 15·0	+0 28·26	−0 31·1	12–8	F	7 39 50·21	9·5177	−19 55 2·8	0·4301$_n$	+0·16 −6·0	11
May 1	7 50 6·4	+1 14·63	−2 34·8	12–8	F	7 52 36·67	9·5071	−15 46 27·6	0·5028$_n$	+0·26 −5·3	12
2	7 50 41·0	−1 14·99	−1 47·0	12–8	F	8 4 45·97	9·4800	−11 37 59·7	0·5599$_n$	+0·37 −4·7	13
3	7 36 39·0	−1 34·18	+4 50·1	6–4	F	8 16 13·36	9·4152	− 7 35 21·1	0·6067$_n$	+0·47 −4·0	14
5	7 38 16·5	−2 22·80	−0 13·6	12–8	F	8 37 36·92	9·3727	+ 0 9 45·8	0·6930$_n$	+0·66 −2·2	15

Notes.

April 12. Moonlight : comet bright and large ; no well-defined condensation for observation.
24. A short faint tail visible.
26. Comet fainter, probably owing to vapour from the south-east.
May 1. Definition extremely bad.

Digitized by Google

COMET, 1894 II. (GALE).

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1894·0.	Dec. 1894·0.	Authority.
	h m s	° ′ ″	
1	3 31 24·12	−54 51 56·5	Three obs., Cape, 1894.
2	3 41 51·83	−54 36 27·7	Three obs., Cape, 1894.
3	3 50 22·28	−54 25 11·2	Three obs., Cape, 1894.
4	4 36 26·66	−51 52 50·4	Three obs., Cape, 1894.
5	5 59 49·67	−43 1 25·3	Three obs., Cape, 1894.
6	6 13 5·29	−40 29 57·8	Four obs., Cape, 1894.
7	6 31 54·53	−37 46 13·5	Three obs., Cape, 1894.
a	6 39 13·84	−34 37 31·0	Three obs., Cape, 1894.
8	6 43 28·89	−34 37 56·0	Equatorial comp. with *a*. $9\frac{3}{4}$ mag.
9	7 0 57·81	−31 21 57·6	Three obs., Cape, 1894.
b	7 12 19·98	−27 41 38·4	Three obs., Cape, 1894.
10	7 14 42·07	−27 45 39·4	Equatorial comp. with *b*. 10 mag.
11	7 39 21·79	−19 54 25·6	Three obs., Cape, 1894.
c	7 50 35·06	−15 38 56·0	Three obs., Cape, 1894.
12	7 51 21·78	−15 43 47·5	Equatorial comp. with *c*. $9\frac{1}{2}$ mag.
13	8 6 0·59	−11 36 8·0	Three obs., Cape, 1894.
14	8 17 47·07	− 7 40 7·2	Three obs., Cape, 1894.
15	8 39 59·06	+ 0 10 1·6	Three obs., Cape, 1894.

COMET, 1894 III. (= TEMPEL, 1873 II.).

OBSERVATIONS WITH 7-INCH EQUATORIAL AND FILAR MICROMETER.

Date.	Cape Mean Time.	Comet—Star. Δ *a*	Comet—Star. Δ δ	No. of Comp.	Observer.	Comet's Apparent R.A.	Log. *p* Δ	Comet's Apparent Dec.	Log. *p* Δ	Star's Red. to App. Place.	Comp. Star.
1894.	h m s	m s	′ ″	*a* δ		h m s		° ′ ″		s ″	
May 8	17 8 16·8	−1 54·14	+1 50·6	8–7	F	23 45 21·36	9·5898*n*	−4 51 8·1	0·6545*n*	+0·14 +1·1	1
9	17 9 3·0	−0 58·79	+4 8·1	12–8	F	23 48 33·20	9·5882*n*	−4 39 22·2	0·6561*n*	+0·16 +1·3	2
10	17 9 39·0		+6 27·3	0–6	F			−4 27 42·8	0·6572*n*	+1·6	3
10	16 55 50·0	−1 0·18		3–0	F	23 51 43·19	9·6049*n*			+0·17	3
June 2	16 49 55·1		−5 53·0	0–4	F			−0 19 12·5	0·6891*n*	+7·0	4
2	17 0 10·1	+0 58·66		8–0	F	1 1 23·76	9·5664*n*			+0·43	4
14	17 1 52·0		+3 12·4	0–4	F			+1 26 1·6	0·7025*n*	+9·7	5
14	17 14 53·0	−0 35·17		6–0	F	1 34 36·39	9·5116*n*			+0·59	5

Notes.

May 8. Circular nebulosity with very slight condensation, about 1′ or less in diameter, very faint.
June 2. Comet excessively faint; air damp.
14. Comet exceedingly faint; star 11^m near it made observation very difficult.

ADOPTED MEAN PLACES OF COMPARISON STARS.

Star.	R.A. 1894·0.	Dec. 1894·0.	Authority.
	h m s	° ′ ″	
1	23 47 15·36	− 4 52 59·8	Three obs., Cape, 1894.
a	23 48 37·31	− 4 52 6·4	Three obs., Cape, 1894.
2	23 49 31·83	− 4 43 31·6	Equatorial comp. with *a*. $9\frac{3}{4}$ mag.
3	23 52 43·20	− 4 34 11·7	Three obs., Cape, 1894.
4	1 0 24·67	− 0 13 26·5	Three obs., Cape, 1894.
5	1 35 10·97	+ 1 22 39·5	Three obs., Cape, 1894.

Digitized by Google

Digitized by Google

PERKINS OBSERVATORY
12/23/35

ANNALS OF THE CAPE OBSERVATORY.

Vol. I.

PARTS 2, 3, & 4.

i 12306.

Digitized by Google

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 2.

AN ACCOUNT

OF

TELEGRAPHIC LONGITUDE OPERATIONS CONNECTING ADEN AND THE CAPE OF GOOD HOPE

IN THE YEARS

1881 AND 1882.

By DAVID GILL, LL.D., (Aberd. and Edin.,) F.R.S., &c.,
HER MAJESTY'S ASTRONOMER AT THE CAPE.

PUBLISHED BY ORDER OF THE BOARD OF ADMIRALTY IN OBEDIENCE TO HER MAJESTY'S COMMAND.

Digitized by Google

Digitized by Google

INDEX.

Page.

INTRODUCTION - - - - - - - - [3]

INSTRUMENTS AND OBSERVATORIES:

Transit-instruments:
- Inclination of axis - - - - - - - [8]
- Corrections for difference of diameters of pivots - - - [9]
- Collimation error - - - - - - - [9]
- Values of micrometer-screws - - - - - - [9]
- Wire intervals - - - - - - - [9]

Clocks - - - - - - - - [10]
Altazimuth - - - - - - - - [10]
Values of zenith distance levels - - - - - - [10]
Barometer - - - - - - - - [10]
Thermometer - - - - - - - - [10]
Huts - - - - - - - - [10]
Dead-beat galvanometers - - - - - - [11]
Sounders - - - - - - - - [11]

METHODS OF OBSERVATION AND REDUCTION:

Definition of a complete Time-determination - - - - [12]
" " " Longitude-determination - - - [12]
Stars used for Azimuth and Clock error - - - - [12]
Collimation error - - - - - - - [13]
Level error - - - - - - - - [13]
Azimuth error - - - - - - - - [13]
Clock error - - - - - - - - [13]
Clock rate - - - - - - - - [14]
Sending and receiving signals - - - - - - [14]
- Land lines - - - - - - - [14]
- Submarine lines - - - - - - [15]

RESULTS OF TIME DETERMINATIONS:

Cape Transit-Circle - - - - - - - [17]
Cape Hut-Transit - - - - - - - [18]
Durban - - - - - - - - [20]
Aden - - - - - - - - [21]
Comparisons between the Clocks used at the Cape - - - - [21]
Personal Equation in comparisons - - - - - [23]
Probable error of a single comparison - - - - - [23]
Definitive errors of Cape Hut-clock on Transit-clock - - - [24]

FORMATION OF DEFINITIVE CLOCK ERRORS AND RATES:

Discussion of the probable errors of time determinations by Messrs. Pett and Freeman at the Cape - - - - - - - [26]
Discussion of the probable error of the rate of the Cape clock, and of its rate at night and by day, and of its definitive rate - - - - [27]
Definitive errors and hourly rates of the Cape Hut-clock - - - [30]
" " " " Durban clock - - - - [32]
" " " " Aden clock - - - - [34]

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

ERRATA.

Volume I., Part 2.

Page.	
[15]	Line 31. *For* Submarine signals *read* Submarine lines.
[26]	Heading. *For* Cape Hut Clock *read* Cape Clocks.
[38]	Line 7. *For* $-\frac{M_r - M_s}{2}$ *read* $+\frac{M_r - M_s}{2}$.
[42]	Line 3. *For* F *read* F_r.
[43]	Last line. *For* F *read* F_m.
[48]	Last two lines. *Transpose* the names Finlay and Pett.
[50]	Finlay sending from Sidereal Clock. *Insert* Pett recording.
[51]	Maclear sending from Sidereal Clock. *Insert* Finlay recording, and Pett recording.
[51]	Pett sending from Sidereal Clock. *Insert* Finlay recording, and Maclear recording.
[52]	Heading of first Table, column 4. *For* P *read* P_s.
[52]	Line 8 from bottom. *For* F_r *read* P_r.
[52]	Line 6 from bottom. *For* minor *read* mirror.
[55]	Table 1. *For* Jan. *read* June.
[58]	Note (2.) *Dele* at $\pm$ 0·35.
[64]	Line 11. *For* Graff Rienet *read* Graaff Reinet.
[66]	Line 4. *For* into *read* placed in.
2	No. 34. Prec. *For* $3^s \cdot 054$ *read* $2^s \cdot 845$.
4	No. 116. Prec. *For* $3^s \cdot 161$ *read* $3^s \cdot 081$.
5	No. 233. *For* $17^h\ 0^m\ 42^s \cdot 37$ *read* $17^h\ 0^m\ 42^s \cdot 71$; *for* $3^s \cdot 336$ *read* $3^s \cdot 106$; *for* 101° 29′ *read* 91° 29′.
36	Heading of Table 1. *For* Diurnal observation *read* Diurnal aberration.

Volume I., Part 3.

13	Reduction to Meridian. *For* $0' 36'' \cdot 9$ *read* $1' 6'' \cdot 1$; *for* $63' 26'' \cdot 4$ *read* $63' 16'' \cdot 4$. Tabular Apparent Declination of Star, *for* 38° 41′ 18″·1 *read* 38° 40′ 39″·3.

Digitized by Google

F. Dangerfield, Lith. 22, Bedford St. Covent Garden. 14066. 4. 67.

Digitized by Google

Digitized by Google

SKETCH MAP OF SOUTH AFRICAN TELEGRAPHS, 1886.

BRITISH BECHUANALAND
STATIONS MAFEKING
SETLAGOLI
TAUNGS
VRYBURG

TRANSVAAL STATIONS
STANDERTON
HEIDELBERG
PRETORIA

GRIQUALAND WEST
ORANGE FREE STATE
BASUTOLAND
NATAL
CAPE COLONY
KAFFRARIA

BARKLY WEST
BOSHOF
HEILBRON
KROONSTAD
VENTERSBERG
NEWCASTLE
BETHLEHEM
HARRYSMITH
WINBURG
LADY SMITH
BEACONSFIELD
KIMBERLEY
BRANDFORT
FICKSBURG
ETCHOWE (Heliograph)
JACOBS DAL
BLOEMFONTEIN
LADY BRAND
ESTCOURT
GREYTOWN
KOFFYFONTEIN
WEPENER
REDDERSBURG
PIETERMARITZBURG
HOPE TOWN
ORANGE RIVER
FAURESMITH
EDENBURG
RICHMOND
DURBAN
Cable to England via Delagoa Bay Mozambique, Zanzibar and Aden. Durban to Aden 3858 miles (Cable)
SMITHFIELD
IXOPO
UMZIMKULU
PHILIPPOLIS
PALMIETFONTEIN
PHILIPSTOWN
BETHULIE
ROUXVILLE
KOKSTAD
HERSCHEL
LADY GREY
DE ARR
COLESBERG
ALIWAL NORTH
Mt FRERE
CARNARVON
BURGHERS DORP
JAMESTOWN
BARKLY EAST
RICHMOND ROAD
HANOVER
NAAUW POORT JUNCN
DORDRECHT
QUMBU
VICTORIA WEST
RICHMOND
MIDDLEBURG
UMTATA
CALVINIA
QUEENSTOWN
TARKASTAD
IDUTYWA
FRASERBURG
CRADOCK
GRAAFFREINET
BUTTERWORTH
ABERDEEN
PEARSTON
COOKHUIS
SEYMOUR
KOMGHA
CLANWILLIAM
BEAUFORT WEST
ADELAIDE
STUTTERHEIM
SOMERSET E.
BEDFORD
FORT BEAUFORT
LOVEDALE
ALICE
KING WILLIAMS TOWN
EAST LONDON
FRASERBURGH ROAD
PIQUETBERG
WILLOWMORE
PEDDIE
PRINCE ALBERT
ALICE DALE
GRAHAMSTOWN
TOUWS RIVER
KLAARSTROOM
MEIRING'SPOORT
SALEM
TULBAGH V.
CERES W.
LADISMITH
CALITZDORP
UNIONDALE
ALEXANDRIA
PORT ALFRED
MALMESBURY
CERES ROAD
OUDTSHOORN
AVONTUUR
UITENHAGE
WORCESTER
MONTAGU
WELLINGTON
ROBERTSON
PORT ELIZABETH
CAPE RECEIFFE
PAARLN.
PAARL
SWELLENDAM
HEIDELBERG
RIVERSDALE
BLANCO
GEORGE
KNYSNA
HUMANSDORP
DURBAN RD
CAPE TOWN
STELLENBOSCH V.
BRAK RIVER
CAPE ST FRANCIS
SOMERSET W.
MOSSEL BAY
SIMONS TOWN
CALEDON
CAPE POINT
BREDASDORP
CAPE L'AGULHAS

REFERENCES.

Cape Colonial Telegraph Lines	*Blue*
Free State	*Orange*
Natal	*Brown*
Railway	*Red*
Projected	*Dotted*

DANGERFIELD. LITH. 22, BEDFORD ST. COVENT GARDEN. 13.4.2.87

Digitized by Google

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 2

CHAPTER I.

INTRODUCTION.

THE desirability of determining the longitude of a great national Observatory with the highest accuracy need hardly be insisted upon.

In the case of the Royal Observatory at the Cape of Good Hope, many subsidiary longitudes depend upon it (especially in connexion with the Transits of Venus of 1874 and 1882), and many observations, previously made at the Cape, could not be accurately reduced till this element had been satisfactorily determined. Soon after my appointment as Her Majesty's Astronomer at the Cape of Good Hope, I received a letter from Professor Simon Newcomb, informing me that he was engaged on the completion of a new Lunar Theory, and, for the more accurate determination of the Constants of that Theory, he was anxious to secure a series of observations of occultations of Stars by the Moon at an Observatory in the Southern Hemisphere.

It gave me much pleasure, in reply, to state that not only would I undertake to make such a series of observations for several years, but that, on examining the records of the Observatory, I had found a large number of unpublished occultations made under the direction of Sir Thomas Maclear, which I would gladly reduce on a uniform system and publish with the least possible delay. To give full value to such observations, it was essential that the longitude of the Observatory should be determined with the highest possible precision, and I resolved to lose no time in arranging the necessary preliminaries.

In 1874, in conjunction with the expedition of Lord Lindsay (now Earl of Crawford and Balcarres) to Mauritius, and with Dr. Löw of the German Mauritius Transit of Venus Expedition, I had assisted in the longitude operations connecting Aden, Suez, Alexandria, Malta, and Berlin; whilst Berlin had been connected with Greenwich by several independent operations. The longitude of Aden had also been determined by the officers of the G.T. Survey of India (*Report of the G. T. Survey of India*, 1876–77), and Suez had been connected with Greenwich, viâ Mokattam (Cairo), Alexandria, and Pothcurnow, by the British Transit of Venus Expedition to Egypt in 1874 (*Account of Observations of the Transit of Venus*, 1874, by Sir George B. Airy, pp. 319–331). There was thus reasonable ground to suppose that the longitude of Aden had been determined with considerable accuracy. It therefore only remained to arrange for the telegraphic connexion of the longitudes of Aden and the Cape.

In 1879, October 6, I addressed a letter to Sir George Airy, pointing out that "before "the end of the year the Cape will probably be in telegraphic connexion with England, "and the question arises whether advantage should not be taken of this circumstance as "soon as possible, to determine the longitude of this Observatory." His encouraging reply, dated 1879, Nov. 13, was "To mention the Galvanic Determination of the longi-

i 12306. 400.—8/84. Wt. 1124.

Digitized by Google

" tude of the Cape of Good Hope Observatory is quite enough, the thing must be done as " soon as may be."

On 1879, December 28, the first message from England by cable to the Cape was received, and I wrote the following day to Sir George Airy, begging him to request from Sir James Anderson the use of the cable and permission to make the necessary preliminary experiments. On 1880, Feb. 12, Sir George writes, " Sir James Anderson will " be very pleased to do everything possible with the cable, Durban — Aden, and to join " up, as desired, at the intermediate stations."

It is unnecessary to follow the long subsequent correspondence, the various proposals that were discussed, and the preliminary experiments that were made. At last, having collected the necessary information, I submitted to the Admiralty (1880, June 30,) a statement of my proposed plans, together with an estimate of the probable cost of the operation.

On 1880, Sept. 20, I accepted the kind invitation of Commodore Richards, C.B. (now Admiral Sir F. Richards, K.C.B.), to accompany him, as his guest, on board H.M.S. " Boadicea " to Durban. Arrived there, I had ample opportunity of making the necessary preliminary experiments to ascertain definitively whether longitude signals could be satisfactorily exchanged between Durban and Aden without the necessity of an intermediate observer at Zanzibar. I found that this could not be done with the ordinary galvanometers in general use. In these instruments the mirror, carrying a very light magnet, is suspended in a tube filled with water. The effect of this is to make the mirror swing more slowly and steadily than if it were suspended in air, and it is found that thus the deflections, indicating letters, can be more certainly distinguished from earth currents.

But such a suspension is not favourable for longitude signals, in which the essential feature is a sharply marked commencement. This condition is best realised with Thomson's air dead-beat galvanometer. In this instrument a very light mirror is delicately suspended by a single silk fibre in an air space formed by a very short cylinder of which the ends are parallel plates of glass. The mirror is circular, of nearly the same internal diameter as the cylinder, and, being perfectly free, it deflects at first sharply, but is soon checked by the cushion of air against which it beats. Hence the name " Dead-beat Galvanometer."

It fortunately happened that there was such a galvanometer at Durban, and I found by its aid that signals sent direct from Aden could be observed with sufficient sharpness for longitude purposes. I immediately telegraphed the fact to the Admiralty.

I had also written 1880, Sept. 18, reporting my proposed visit to Durban, and pointing out that the existing contract for the Mail Service between Durban and Zanzibar expired on 1881, Feb. 9, that it would not probably be renewed, and that, unless one of H.M. gunboats was available to convey the observer from Durban to Delagoa Bay, it was essential that the operation should be sanctioned without delay.

On my return to the Cape (Oct. 15) I received authority by telegraph to proceed at once with the work. The necessary huts were built at the Observatory, a foundation at the selected site was prepared at Durban, and I only waited the arrival of the Clocks and Transit Instruments from Greenwich to begin the work.

These instruments had been the subject of considerable previous correspondence, and I did not doubt that they were now on their way to the Cape. Unfortunately this was not the case; it occurred to Sir George Airy that Alt. Azimuths might be substituted, with advantage, for Transit Instruments; this created delay. Then disturbances broke

Digitized by Google

out amongst the natives of the Transkei; the land lines on the Natal border of the Cape were cut by the rebels, and on 1880, Nov. 4, Sir George Airy wrote me that he considered "the longitude enterprise was absolutely suspended for the present." I replied by return of post (1880, Nov. 27) to this letter, pointing out the extreme inconvenience of postponing the operation, or of changing methods which had been carefully considered, and for which considerable preparation had already been made in the selection and observation of stars to be employed. I urged that the Clocks, Chronometers, Transit Instruments, and Galvanometers should be placed at my disposal as soon as possible, to be tested and ready for action whenever a favourable opportunity should offer.

On 1880, Dec. 25, Sir George Airy announced, in reply, that 18 cases containing—

3 Transit Instruments,
1 Altazimuth,
3 Clocks,

had been forwarded, but, for some cause, they did not reach the Cape till 1881, March 1.

The Instruments arrived in perfect order; one Transit was erected in the Observatory grounds, a series of personal equation determinations was made, and I was about to sail for Durban on March 18, when news was received that the telegraph lines had been broken down by floods in the Transkei.

As this involved the delay of a month (because steamers only sail once a month from Durban to Delagoa Bay), I asked and obtained Admiralty permission to postpone the operation for three months, meanwhile to go to England on urgent private affairs.

When in England, I received "carte blanche" as to details, the operation to be carried out when and how I saw fit, provided only that the actual cost should not unreasonably exceed the estimated amount. The delays in starting the work had now extended nearly over the time which the whole work would have occupied, and, as I had planned for the commencement of other investigations about Midsummer, 1881, I resolved to modify the original longitude programme, and relegate to my chief assistant, Mr. Finlay, the part of chief travelling observer.

This enabled me to exercise a more efficient control over the operation as a whole, and at the same time to carry out my plans for Heliometer researches on Stellar Parallax, which would otherwise have been postponed for nearly a year. I had every confidence in the devotion and skill of Mr. Finlay, a confidence that has been amply justified by results.

In arranging the definitive programme of operations, the point I had to keep most constantly in view was the determination or elimination of personal equation. In ordinary longitude operations this is done by exchanging the observers, and such exchanges can generally be accomplished without much fear of change in the personal equation of the observers. But when, from delays and irregularities in transport, and from the great distances separating the terminal stations, the operations must extend over many months, it is by no means certain that the personal equation of the observers will remain constant, particularly when long sea voyages and great changes of climate, as well as changes in the bodily health of observers, have to be encountered. The leading idea of my plan was therefore to refer the personal equation of the travelling observers [Finlay and Maclear] to that of two stationary observers [Pett and Freeman], whose relative personal equation had remained practically constant since 1879, and which, as the event proved, remained also constant during the whole operation.

Digitized by Google

Reference to the accompanying map and the following Table will convey to the reader a clear idea of the operation as a whole. Submarine cables are shown by red lines, land wires by solid black lines.

It will be observed that the operation divided itself into two distinct parts, viz., Cape—Durban by land lines, and Durban—Aden by submarine lines.

The following Table will convey to the reader at a glance the arrangement of the observers and the plan on which the operation was actually carried out.

——	Cape.	Durban.	Aden.
1881. April and May -	Intercomparisons of personal equation by all observers.	—	
June 4–27 (1) -	Maclear - - - Pett. Freeman.	Finlay. Signals exchanged with the Cape on June 17, 21, 22, 27.	—
Aug. 6 (2)—Oct. 5	Pett - - - Freeman.	Maclear. Exchanges with Cape, Aug. 18, 19, 26, 27; Sept. 3, 19. Exchanges with Aden, Aug. 23, 26; Sept. 2, 3, 13, 18, 19, 22, 23, 26, 28.	Finlay.
Nov. 15 (1)—Dec. 7	- - - -	Finlay and Maclear. Comparison of Personal Equations, both in time determinations and in observing mirror signals.	—
1881. 1882. Dec. — Jan. -	Finlay - - - Pett. Freeman.	Maclear. Exchanges with Cape, Dec. 23; Jan. 8, 14, 20, 21, 27.	—
1882. February -	Intercomparison for personal equation by all observers.	—	—

In all the preceding observations Finlay and Maclear observed with portable Transit Instruments; Pett and Freeman with the Transit Circle.

---

(1) In the long intervals, June 27 to August 6, and October 5 to November 15, Mr. Finlay was *en route* between Durban and Aden. He availed himself of the necessary stoppages at Delagoa Bay, Quilimane, Mozambique, and Zanzibar, both going and returning from Aden, to determine the longitudes of these stations.

The reader will find an account of these operations, *Monthly Notices*, R.A.S., Vol. XLIII., p. 483. The results will also be found at the conclusion of the present work.

(2) In August I accompanied Mr. Maclear to Durban and organised the arrangements for exchange of submarine signals between Durban and Aden. So soon as all was in perfect working order, I returned to the Cape.

Digitized by Google

In the following observations both Finlay and Pett observed with portable Transits:—

1882. May -	Finlay and Pett. Comparison of Personal Equation.	—
July -	Finlay.	Pett. Exchange of signals with Cape, July 10 and 13.
December 1883. January.	Finlay and Pett. Comparison of Personal Equation.	—

The weakest point in the operation may be considered the want of exchange of observers at Aden and Durban. This was provided for in the original programme, but the cessation of regular communication between Durban and Aden, which occurred after the preparation of that programme, rendered it necessary to give up this plan, and to substitute that of determining the difference of personal equation in observing mirror signals with an additional comparison of personal equation at Durban. The result is probably not less satisfactory than if the original plan had been carried out.

Digitized by Google

CHAPTER II.

DESCRIPTION OF INSTRUMENTS AND OBSERVATORIES.

The Transits were three of five identical instruments constructed by Troughton and Simms, to the order of Sir George B. Airy, for use on the Transit of Venus Expedition of 1874; they are described in his "*Account of Observations of the Transit of Venus*, 1874, December 8, pp. 9–10.

The Transit employed at the Cape was that used at Rodriguez in 1874. It was mounted in a wooden hut 36 feet East and 373 feet South of the Cape Transit Circle, upon stone piers sent out with the instrument from England.

Time determinations at the Cape were also, as a rule, made by the fixed observers, Pett and Freeman, with the Transit Circle of the Royal Observatory (an instrument almost identical with the Greenwich Transit Circle), on nights when signals were exchanged between the Cape and Durban.

The Transit employed at Durban was that used at Honolulu in 1874. The instrument had however, at my request, been provided with a heavy cast-iron stand, to save the cost of transport and loss of time involved in the erection of heavy stone piers. This stand was bolted to a concrete pier cast *in situ* upon a wide and deep foundation of solid concrete.

The Transit employed at Aden was that used at Mokattam in 1874. It was mounted on a cast-iron stand similar to the Durban instrument, and this was bolted to a strong piece of masonry founded on the solid rock.

The methods of observation with the Cape Transit Circle are sufficiently described in the recent annual volumes of the Cape Observatory, and need not be further alluded to here.

The inclination of the axis of the portable Transits was determined throughout by means of a hanging level (furnished with a cross level) applied to the pivots. To determine the values of these levels, they were mounted on the nearly horizontal surface of the cube of the Cape Transit Circle. The inclination of this surface was then changed by a small amount in Declination, the amount of change being measured by the level and by the microscopes of the Circle. In this way the following *values of one division of the level* were obtained for each instrument:—

		div.		Adopted.
			"	"
Cape Transit.—Before the Expedition,		1 =	1·280	1·300
	After	,,	1·308	
Durban Transit.—Before		,,	1·400	1·400
	After	,,	none	
Aden Transit.—Before		,,	0·920	0·910
	After	,,	0·897	

Digitized by Google

These values do not accord very satisfactorily with the following values, determined by the makers and adopted for the reduction of the observations in connection with the Transit of Venus in 1874; viz:—

	div.	=	"
Cape Transit,	1	=	1·538
Durban Transit,	1	=	1·304
Aden Transit,	1	=	1·200

Still the accordance of the Cape results, and the care taken to eliminate all sources of systematic error, warrant their adoption.

The corrections for difference of diameter of the pivots were determined for each Transit. The corrections, applied to the apparent level error for inequality of pivots with Lamp West, are—

Cape Transit.	Durban Transit.	Aden Transit.
d	d	d
0·00	+ 0·22	− 0·19
	sec	sec
	(= + 0·020)	(= − 0·012)

The separate results for inclination of the axis are given in connexion with the observations at each station.

The Collimation Error at the Cape was determined by bisecting, with the Centre web, (1) cross wires in the foci of two small telescopes (mounted on piers outside the Hut), one to the North, the other to South of the Transit instrument. The Transit was then reversed, and the cross-webs of both small telescopes again bisected. The resulting reading for Geometric Collimation should be the same for reversals in front of both Collimators, the difference (apart from accidental error of observation) is due to change of azimuth in reversal, but the mean reading is free from such error.

At Durban the error of Collimation was similarly determined. A small telescope on a pier outside the Hut was used as one Collimator. A small portable Transit instrument mounted on a pier provided for carrying the Altazimuth was used by Mr. Maclear, Mr. Finlay used the telescope of the Altazimuth itself as the other Collimator.

At Aden the Altazimuth was similarly employed as a Collimator.

At Aden errors produced by change of Azimuth in reversal were guarded against by re-reversal, and if the original reading before reversal was not approximately reproduced, a second and more careful trial was made, till consistent results were obtained. It was very seldom, however, that the observation had to be repeated. The separate results of the reading for Geometric Collimation are given in connection with the observations at each station.

The values of the micrometer-screws are—

Cape Transit.		Durban Transit.	Aden Transit.
rev.	s	s	s
1 =	3·743	3·741	3·761

derived from measures of the wire intervals in terms of the screws combined with the known wire intervals.

The Wire Intervals.—These were determined from all the complete transits of circumpolar stars observed.

(1) The transit webs of all the Transit instruments are mounted upon the slide moved by the Collimation-Micrometer-Screw.

Digitized by Google

The following are the corrections for an Equatorial Star to the centre wire "Lamp West":—

	Cape Transit.	Durban Transit.	Aden Transit.
	s	s	s
Wire I.	+ 28·604	+ 28·348	+ 28·605
II.	+ 14·257	+ 14·369	+ 14·167
III.	+ 4·764	Wanting.	Wanting.
IV.	0·000	0·000	0·000
V.	− 4·602	Wanting.	Wanting.
VI.	− 14·182	− 14·337	− 14·214
VII.	− 28·246	− 28·370	− 28·581

The corrections to the middle wire for the Durban Transit are in Mean Time, those for the Cape and Aden Transits in Sidereal Time.

The Hut Clocks.—These are all by E. Dent & Co. They are quite identical in construction, and all fitted with the well-known cylindrical zinc and steel tubular compensation pendulums constructed by that firm.

The Cape Hut Clock was bolted to a brick pillar in the observing hut. It was regulated to sidereal time.

The Durban Hut Clock was that used at Honolulu in 1874. It was mounted on a massive tripod stand of mahogany and iron which rested on three short concrete piers cast *in situ* upon the same concrete foundation on which the Transit Pier rested. This clock was regulated to Mean Time. The observer employed a pocket watch set to Sidereal Time for convenience in finding stars; but transits were observed by means of beats of the Mean Time Clock.

The Aden Hut Clock was that used at Mokattam in 1874. It was mounted similarly with the Durban Clock, the feet of its tripod resting on short piers of masonry founded on the solid rock. This clock was regulated to Sidereal Time.

The Altazimuth employed for determining the latitude of the stations at Durban and Aden is one of the three instruments of the kind made for the Transit of Venus Expedition of 1874, and described at page 18 of Sir George Airy's work above referred to. It is, in fact, the instrument employed at Honolulu; and it was afterwards employed by the Rev. Fathers Perry and Sidgreaves on the British Transit of Venus Expedition to Madagascar in 1882.

The values of the zenith-distance levels were determined as follows:—

	"
for level *e.f.*, 1 div. =	1·808
g.h., 1 „ =	1·714

The Barometer employed was a mercurial travelling barometer by Negretti and Zambra. Its index error was insignificant.

The Thermometer belonged to an old set of magnetic instruments by Elliott, and required an index correction of − 0°·8.

The Huts at the Cape, Durban, and Aden were all alike built of wood on a plan furnished by Sir George Airy, which I believe was originally designed by him for the Transit instrument of Struve and Döllen erected at Greenwich in connection with the celebrated "Expédition Chronométrique" of 1843; a like model was afterwards used on

Digitized by Google

the Transit of Venus Expedition of 1874. The three huts constructed at the Cape were just of sufficient size to contain the clock on its tripod, the Transit Instrument on its pier, the Altazimuth on its pier; also a shelf with the telegraph key and sounder, and at Aden and Durban an insulated pier for the dead-beat galvanometer.

The Dead-Beat Galvanometers were of the usual Thomson type. That employed at Aden was ordered from England at my request by Mr. Stacey, Telegraph Superintendent at Aden; the other was kindly lent by Mr. Carlisle, Telegraph Superintendent at Durban.

The Sounders for land-line signals were made specially at the Government Telegraph workshops in Cape Town, and each consisted of a light vertical hammer having an armature attached to its handle. A very slight current was sufficient to move the armature, and cause the hammer head to strike a metal plate with a sharp "click."

Digitized by Google

CHAPTER III.

METHODS OF OBSERVATION AND REDUCTION.

With the portable Transits a Time Determination was defined as follows:—

Step 1.	Collimation Determination.	1st Half Determination.
2.	Level Determination with reversals and re-reversals of the level.	
3.	Observe Transits of 4 Time Stars; and one Circumpolar Star at upper and one at lower Transit.	
4.	Level—as before.	
5.	Reverse Transit Instrument.	
6.	Level—as before.	2nd Half Determination.
7.	Observe Transits of 4 Time Stars; and one Circumpolar Star at upper and one at lower Transit.	
8.	Level—as before.	
9.	Collimation Determination.	

All Transits were observed by "*eye and ear*."

As the effect of collimation was eliminated by reversal in *every* complete observation, the observers did not always perform Step 9.

A complete determination of longitude was supposed to consist of such a time-determination at both stations before and after the exchange of signals, but it was found necessary to relax this condition somewhat, because of the interruptions by cloudy weather which would have unduly prolonged the operation if this condition had been invariably insisted upon.

I have, therefore, accepted all results in which there is a complete time-determination at both ends within 2 or 3 hours before or after exchange of signals. I have also accepted those cases where the stars were observed Lamp West before the signals and Lamp East after the signals, or *vice versâ*, but in such cases the clock rate has not been deduced from the observations of the same night, but from other independent sources. But in no case has any time-determination been accepted in which observations have not been made in reversed positions of the instrument.

In order that the observer should lose no opportunity of observing, the following lists of stars were prepared:—

I. A list of 389 Time Stars situated between Declination + 12° and − 29°, that is, between the Zenith of Aden and Durban respectively (1), and all as far as possible about 6th magnitude.

From this list an observer could always find suitable Time Stars at every 3 or 4 minutes of R.A., so that no opportunity for observing need be lost. The places of these stars were determined by the Cape Transit Circle with, as a rule, a minimum of 6 observations of each in R.A. The resulting mean places are given in Section I., pp. 2–7.

(1) The reason for this will become evident in the discussion of the Personal Equation Determination.

Digitized by Google

II. A list of 87 Southern Circumpolar Stars was prepared, conveniently selected for the determination of Azimuth, so that the observer could find an Azimuth Star either at upper or lower culmination every 7 or 8 minutes. These stars were also observed with the Cape Transit Circle. The resulting mean places are given in Section II., pp. 10–13.

III. A list of the most suitable Northern Circumpolar Stars was also prepared for use at Aden.

The mean places of those actually employed in the operation, with the authorities on which they depend, are given in Section III., p. 16.

The *Collimation Error* (*c*) has been determined from the special observations for the purpose made each night. In the Tables of "Adopted Collimation" the correction for diurnal aberration has been combined with the correction for Collimation.

The *Level Error* (*b*) has been adopted from the observations of level before and after each half-time determination, that is, from Steps 2 and 4 or 6 and 8.

When the determinations of level before and after star observations agree closely, the mean of the two determinations corrected for difference of diameter of the pivots is adopted as the true inclination of the axis for all the stars of that half-time determination. When the difference of such determinations exceeds 1″ of arc, the level error is interpolated for each star. In the Table of Level Errors an asterisk (*), placed between two values, denotes that the level errors applied to the observations have been interpolated, according to the time between these values.

The *Azimuth* (*a*) has been deduced at the Cape and Durban from the difference between the computed apparent Right Ascension of two pole stars (one in upper, one in lower transit), compared with the difference of their observed Right Ascensions when corrected only for Collimation, level, and clock rate.

It is assumed, in all cases, that the Azimuth may shift by the act of reversing the Transit; thus each half time-determination is reduced quite independently of any other.

At Aden it was not always possible, from the low altitude of the pole, to observe stars in lower transit. The Azimuth was in such cases deduced by combining the observations of pole stars with those of time stars in the usual way.

The *Clock Errors* have been deduced by application of the corresponding corrections for Collimation, Level, and Azimuth to the Transit of each star.

The clock correction Δt is then—

Δt = Star's Tabular Apparent R.A. (1)—Clock Time of Meridian Transit.

The separate results so obtained will be found—

For the Cape Transit Circle,	Pett's	Observations,	Section IV.,	pp.	24–29.
,, ,, ,,	Freeman's	,,	,,	,,	30–33.
For the Cape Hut Clock	Finlay's	,,	Section V.	,,	36–43.
,, ,, ,,	Maclear's	,,	,,	,,	44–51.
,, ,, ,,	Pett's	,,	,,	,,	51–53.
For the Durban Hut Clock	Finlay's	,,	Section VI.	,,	56–59.
,, ,, ,,	Maclear's	,,	,,	,,	60–71.
,, ,, ,,	Pett's	,,	,,	,,	72–73.
For the Aden Hut Clock	Finlay's	,,	Section VII.	,,	76–83.

(1) At Durban a Mean Time Clock was employed, therefore, instead of "Star's Tabular Apparent R.A.," the "Tabular Mean Time of Star's Culmination" has been substituted in the expression for Δt.

Digitized by Google

To deduce the definitive value of Δt for each half determination, the means of these separate results of the clock stars and their epochs has been separately taken for Lamp East and Lamp West. The mean of the two half determinations (without regard to the number of observations in each) has been adopted as the epoch and value of Δt in each determination.

The clock rate is derived from observations of the previous and following day, corrected, if necessary, for systematic difference of rate by night and by day.

I have in no case employed the method of least squares. The Azimuth errors are all so strongly determined by the adopted methods, and the Azimuth factors of the Time stars so comparatively small, that no result differing more than $0^s \cdot 01$ or $0^s \cdot 02$ from the adopted values would be arrived at. Such quantities are insignificant compared with the unavoidable changes of personal equation, and would quite disappear from the mean results.

The *Sending of Signals* in coincidence with the beat of a clock is an art that is soon acquired by any experienced observer, and is capable of being performed with great accuracy, as will afterwards be proved by the results of personal equation determinations of this kind.

Signals on land lines were sent according to the following programme.

Programme.

When both ends were ready and through communication was established, the Cape observer sent a rattle at 40^s by his clock, omitted 50^s, and began sending regularly at intervals of 10^s at the even minute. This was continued for 8 minutes, and ended with a rattle a few *seconds* after the last signal. The Durban observer then sent similar signals for 15 minutes, and finally the Cape observer again for 8 minutes. The times of the first and last signals were communicated by the sending station to the other.

Signals on land lines were received according to the following programme. The reader will bear in mind that the clock in Durban (the middle station) was regulated to mean time, the clocks at the Cape and Aden to Sidereal Time.

Programme.

The time at which the click of the sounder was heard was noted (to $0^s \cdot 1$) for every signal, but special attention was paid to the signals received when nearly and quite in coincidence with the beat of the clock. When the coincidence was quite passed, the observer made a mark among his records where he judged the coincidence really to have taken place. The following is an example how this was done:—

Digitized by Google

1881, June 22nd.—Observatory sending, Durban receiving. The following observations appear in the Durban observer's book near the time of coincidence :—

h	m	s	
10	48	38·1	
		48·1	
		58·05	
	49	8·	scarcely up
⟹		18·	up and exact
		28·	up
		38·	past, I think
		48·	past
		57·95	
	50	7·95	
		17·9	

These coincidences, marked with an arrow-head, have alone been made use of in the reductions. (1)

By this method coincidences could be estimated with very considerable accuracy.

Signals on submarine lines were sent in the same manner as those on land lines, excepting that the key was longer pressed and the cable was discharged by a reverse current, and that signals were sent at longer intervals to allow time for the mirror to become steady.

The programme of sending was as follows :—

When Aden and Durban were ready, Zanzibar joined through for 3 min. and trial signals were exchanged. This was found necessary as Aden could not talk direct to Durban. Then, if all was satisfactory, Zanzibar joined through for an hour and five minutes. Durban commenced with rapid warning signals at the following 40th sec. by Durban clock, and the first signal was sent at the following even minute. The signals were sent at intervals of 20 seconds for 15 minutes, two signals being omitted, one near the beginning, the other near the end. Aden then sent for 30 minutes, 3 signals being omitted, and Durban again sent for 15 minutes.

When Zanzibar broke in, the clock times of omitted signals were mutually communicated.

Mirror signals on Submarine signals were received according to the following programme :—

The first sensible start of the spot of light was observed in every case. The times at which this start was observed were entered for every signal, and special attention paid to those near coincidence. When the coincidence was quite passed, the observer drew an arrow among his records where he judged the coincidence to have been, as in the case of the land line signals.

(1) The arrow-head being placed between the signals $10^h\ 49^m\ 18^s$ and $10^h\ 49^m\ 28^s$, the mean of these signals is taken as the time of coincidence. When the observer places the arrow-head opposite a particular signal, that signal is adopted as the time of coincidence.

Digitized by Google

In the reductions which follow I find it convenient for future discussion to denote the effects of personal equations by symbols.

In observations for Clock Error with small Transits put—

True value of Δt	= Finlay's observed value	+ F′
	= Maclear's	+ M′
	= Pett's	+ P′

In observations with the Transit Circle put—

True value of Δt	= Pett's observed value	+ P.
	= Freeman's	+ I.

In sending signals in coincidence with a clock-beat, put—

True Clock Time of Signals	= Finlay's nominal time	+ F_s
	= Maclear's	+ M_s
	= Pett's	+ P_s

In receiving land line signals, put—

True Clock Time at which the signal arrived	= Finlay's recorded time	+ F_r
	= Maclear's	+ M_r
	= Pett's	+ P_r

In receiving mirror signals on submarine lines, put—

True Clock Time at which mirror signal arrived	= Finlay's recorded time	+ F_m
	= Maclear's	+ M_m

In comparing the two sidereal clocks at the Cape by Mean Time Chronometers, put—

True value of Hut Clock Slow of Transit Clock	= Finlay's result	+ F_c
	= Maclear's	+ M_c
	= Pett's	+ P_c

Digitized by Google

CHAPTER IV.

THE RESULTS OF TIME DETERMINATIONS.

The following Tables exhibit the results of all complete Time-Determinations which enter into the Longitude Operations.

TABLE A.—TIME-DETERMINATIONS WITH THE CAPE TRANSIT CIRCLE.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
April 9 - -	10 2	−89·216	12 21	−89·332	11 11	−89·274 + P.
	10 50	·005	11 53	·023	11 21	·014 + I.
April 13 - -	10 7	−92·362	10 54	−92·440	10 30	−92·401 + I.
April 14 - -	10 2	−93·462	12 23	−93·610	11 13	−93·536 + P.
	10 46	·184	11 52	·253	11 19	·219 + I.
May 12 - -	11 54	−57·550	14 18	−57·677	13 6	−57·614 + P.
	12 24	·265	13 46	·363	13 5	·314 + I.
May 20 - -	11 53	−65·463	12 59	−65·533	12 26	−65·498 + P.
May 23 - -	13 4	−68·727	13 56	−68·743	13 30	−68·735 + P.
	12 16	·410	14 55	·580	13 36	·495 + I.
June 16 - -	12 59	−32·045	18 11	−32·340	15 35	−32·193 + P.
	13 46	−31·835	18 13	·145	16 0	−31·990 + I.
June 17 - -	12 59	−32·955	18 15	−33·198	15 37	−33·077 + P.
	13 46	·843	17 17	−32·900	15 32	−32·872 + I.
June 20 - -	13 37	−35·673	18 12	−35·740	15 55	−35·707 + P.
	14 11	·535	17 18	·543	15 45	·539 + I.
June 21 - -	13 40	−36·400	20 18	−36·563	16 59	−36·482 + P.
	14 11	·253	19 15	·353	16 43	·303 + I.
June 22 - -	13 37	−37·120	18 13	−37·393	15 55	−37·257 + P.
	14 11	·005	17 18	·193	15 45	·099 + I.
June 27 - -	13 58	−42·303	18 35	−42·538	16 17	−42·421 + P.
	14 51	·118	18 12	·305	16 32	·212 + I.
August 18 - -	16 26	−32·453	21 26	−32·578	18 56	−32·516 + P.
	17 23	·240	20 19	·405	18 51	·323 + I.
August 19 - -	16 39	−33·388	22 6	−33·527	19 23	−33·458 + P.
	17 14	·205	21 29	·343	19 22	·274 + I.
August 25 - -	16 51	−38·963	20 58	−39·073	18 55	−39·018 + P.
	17 42	·736	20 43	·833	19 13	38·785 + I.
August 26 - -	16 49	−39·778	21 40	−39·973	19 15	−39·876 + P.
	17 42	·638	20 44	·793	19 14	·716 + I.
August 27 - -	17 1	−40·920	21 30	−41·115	19 16	−41·018 + P.
	17 42	·745	20 38	·900	19 10	−40·823 + I.

Digitized by Google

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
August 28 - -	16 35	−42·120	21 29	−42·313	19 2	−42·217 + P.
	18 10	41·938	20 43	·110	19 27	·024 + I.
September 3 -	17 36	−47·848	21 57	−48·045	19 47	−47·947 + P.
September 19 -	18 25	−63·683	23 14	−63·868	20 50	−63·776 + P.
	19 30	·473	21 41	·518	20 36	·496 + I.
December 23 -	2 4	−40·832	7 47	−40·678	4 56	−40·755 + P.
	3 16	·465	7 8	·280	5 12	·373 + I.
December 29 -	—	—	—	—	2 48	−38·085 + P.
	—	—	—	—	3 24	−37·743 + I.
December 30 -	3 45	−37·623	6 32	−37·523	5 9	−37·573 + P.
1882.						
January 8 - -	—	—	—	—	4 58	−33·918 + P.
January 9 - -	—	—	—	—	3 50	−33·496 + P.
	—	—	—	—	3 45	·315 + I.
January 14 - -	—	—	—	—	3 32	−31·700 + P.
January 17 - -	3 45	−30·703	6 39	−30·668	5 12	−30·685 + P.
January 20 - -	4 13	−29·675	6 50	−29·688	5 32	−29·682 + P.
January 21 - -	4 34	−29·340	7 10	−29·314	5 52	−29·327 + P.
	5 3	·143	6 15	·138	5 39	·141 + I.
January 26 - -	—	—	—	—	4 44	−27·696 + P.
January 27 - -	—	—	—	—	4 40	−27·510 + P.
January 28 - -	—	—	—	—	4 50	−27·108 + P.
February 13 - -	5 33	−21·948	8 30	−21·848	7 2	−21·898 + P.
	6 27	·720	7 30	·726	6 58	·723 + I.
February 14 -	5 32	−21·598	8 30	−21·502	7 1	−21·550 + P.
	6 27	·315	7 33	·353	7 0	·334 + I.
February 15 - -	6 27	−21·155	7 30	−21·152	6 59	−21·154 + P.
	5 33	·012	8 30	·034	7 1	·023 + I.
February 17 -	6 27	−20·415	7 29	−20·364	6 58	−20·390 + P.
	5 33	·206	8 33	·090	7 3	·148 + I.

TABLE B.—TIME-DETERMINATIONS with the CAPE HUT TRANSIT.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
April 9 - -	—	—	—	—	11 12	−31·605 + F′.
					11 21	·475 + M′.
April 13 - - -	—	—	—	—	10 30	−37·045 + M′.
April 14 - -	—	—	—	—	11 17	−37·422 + F′.
					11 12	·255 + M′.

Digitized by Google

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
May 12 - -	—	—	—	—	13 5	−35·145 + F′.
					13 5	·005 + M′.
May 20 - - -	—	—	—	—	12 26	−33·825 + M′.
May 23 - -	—	—	—	—	13 30	−32·825 + F′.
					13 36	·730 + M′.
June 16 - - -	13 31	−23·145	18 54	−23·090	16 12	−23·118 + M′.
June 17 - -	13 39	−23·130	17 52	−23·145	15 46	−23·138 + M′.
June 20 - - -	13 54	−22·725	17 35	−22·745	15 45	−22·735 + M′.
June 21 - -	13 48	−22·575	20 28	−22·595	17 8	−22·585 + M′.
June 22 - - -	13 51	−22·305	17 43	−22·390	15 47	−22·348 + M′.
June 27 - -	—	—	—	—	13 58	−20·065 + M′.
December 23 - -	3 11	−36·110	7 48	−36·295	5 30	−36·203 + F′.
December 30 -	—	—	—	—	5 12	−42·865 + F′.
1882.						
January 17 - -	—	—	—	—	5 19	−66·430 + F′.
January 20 - -	—	—	—	—	5 38	−71·255 + F′.
January 26 - -	—	—	—	—	5 8	−22·695 + F′.
January 27 - -	—	—	—	—	5 22	−24·975 + F′.
January 28 - -	—	—	—	—	4 57	−27·135 + F′.
February 13 - -	—	—	—	—	6 58	−59·945 + F′.
					7 2	·910 + M′.
February 14 -	—	—	—	—	7 2	−60·265 + F′.
					7 0	·345 + M′.
February 15 - -	—	—	—	—	7 2	−62·465 + F′.
					6 58	·375 + M′.
February 17 -	—	—	—	—	6 58	−66·450 + F′.
					7 2	·355 + M′.
May 22 - - -	—	—	—	—	12 45	−67·098 + F′.
					12 44	·188 + P′.
May 27 - -	—	—	—	—	12 42	−14·364 + F′.
					12 31	·274 + P′.
July 10 - - -	15 51	−78·682	19 21	−78·785	17 36	−78·734 + F′.
July 13 - -	15 44	−82·442	19 9	−82·582	17 27	−82·512 + F′.

Digitized by Google

TABLE C.—TIME DETERMINATIONS AT DURBAN.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
	h m	s	h m	s	h m	s
1881.						
June 17 - -	—	—	—	—	13 50	−44·243 + F′.
June 21 - -	8 12	−35·575	14 31	−36·050	11 22	−35·813 + F′.
June 22 - -	7 47	−38·165	12 39	−37·490	10 13	−37·828 + F′.
June 27 - -	—	—	—	—	8 53	−32·005 + F′.
August 18 - -	8 0	−29·135	12 7	−28·770	10 4	−28·953 + M′.
August 19 - -	7 47	−27·725	12 44	−27·485	10 16	−27·605 + M′.
August 20 - -	7 20	−26·485	12 25	−26·275	9 52	−26·380 + M′.
August 23 - -	7 2	−23·360	12 25	−22·990	9 44	−23·175 + M′.
August 29 - -	7 19	−13·400	11 31	−13·160	9 25	−13·280 + M′.
September 2 -	—	—	—	—	7 8	− 9·153 + M′.
September 13 -	—	—	—	—	7 26	−58·085 + M′.
September 18 -	—	—	—	—	7 18	−51·630 + M′.
September 19 -	7 6	−50·810	13 38	−50·540	10 22	−50·675 + M′.
September 22 -	7 0	−46·895	13 26	−46·437	10 13	−46·666 + M′.
September 23 -	7 23	−45·420	11 56	−45·337	9 39	−45·379 + M′.
September 26 -	7 44	−41·527	12 57	−41·315	10 21	−41·421 + M′.
September 28 -	—	—	—	—	7 12	−39·355 + M′.
November 20 -	—	—	—	—	11 50	−49·510 + F′.
	—	—	—	—	10 38	−49·318 + M′.
November 21 -	—	—	—	—	13 34	−49·043 + F′.
	—	—	—	—	13 24	−48·748 + M′.
November 26 (1) -	—	—	—	—	12 18	−43·485 + F′.
	—	—	—	—	12 2	−43·012 + M′.
November 27 (1) -	—	—	—	—	10 51	−42·333 + F′.
	—	—	—	—	10 40	−42·510 + M′.
December 23 -	9 23	−21·740	14 18	−21·580	11 50	−21·660 + M′.
1882.						
January 8 - -	—	—	—	—	16 27	−13·595 + M′.
January 14 - -	—	—	—	—	10 32	−10·410 + M′.
January 20 - -	—	—	—	—	16 37	− 6·940 + M′.
January 21 - -	—	—	—	—	10 29	− 6·712 + M′.
January 27 - -	9 20	− 5·945	13 0	− 5·865	11 10	− 5·905 + M′.
July 10 - -	8 19	−45·655	12 24	−45·458	10 22	−45·557 + P′.
July 13 - -	8 25	−41·500	12 12	−41·364	10 19	−41·432 + P′.

(1) On November 26th both F. and M. observed all the stars Lamp E., and on November 27th all the stars Lamp W. It is necessary to combine these results, as, for some reason which I cannot explain, both observers appear to make systematic errors in opposite directions in the two positions of this Instrument.

Digitized by Google

TABLE D.—TIME-DETERMINATIONS AT ADEN.

Date.	1st Time Determination.		2nd Time Determination.		Mean.	
1881.	h m	s	h m	s	h m	s
August 20 - -	—	—	—	—	18 27·5	− 4·710 + F′.
August 21 - -	—	—	—	—	19 31	−20·900 + F′.
August 23 - -	—	—	—	—	19 31	−51·750 + F′.
August 26 - -	19 22	−36·860	0 45	−37·240	22 4	−37·050 + F′.
	Lamp West.		Lamp East.			
August 27 - -	18 8	−38·630	22 6	−39·030	20 7	−38·830 + F′.
August 29 - -	19 16	−42·510	23 20	−42·800	21 18	−42·655 + F′.
September 2 -	—	—	—	—	22 20	−50·035 + F′.
	Lamp East.		Lamp West.			
September 3 -	22 19	−51·86	1 31	−52·19	23 55	−52·025 + F′.
September 13 -	—	—	—	—	20 32	−46·345 + F′.
September 15 -	—	—	—	—	22 30	−45·930 + F′.
September 18 -	21 20	−45·355	2 8	−45·210	23 44	−45·283 + F′.
September 19 -	21 20	−45·075	3 3	−45·010	0 12	−45·043 + F′.
September 22 -	—	—	—	—	21 18	−44·670 + F′.
September 23 -	21 44	−44·380	1 50	−44·335	23 47	−44·358 + F′.
September 24 -	—	—	—	—	22 5	−44·155 + F′.
September 25 -	—	—	—	—	22 35	−44·065 + F′.
September 26 -	—	—	—	—	21 42	−43·850 + F′.
September 27 -	—	—	—	—	21 47	−43·670 + F′.
September 28 -	22 16	−43·470	3 15	−43·420	0 46	−43·445 + F′.

Observations for time were made at the Cape with two clocks, the Transit Clock and the Hut Clock, but all the signals were sent by and received with the Hut Clock.

The two clocks in question were therefore compared through mean time chronometers by coincident beats. Each observer, before work, compared his chronometer by coincidence with his clock, then carried the chronometer to the other clock and made two comparisons by coincidence, finally making a second comparison by his chronometer with his own clock.

These two symmetrically arranged coincidences of the chronometer with each clock by each observer were considered to give a complete comparison; a like complete comparison of the clocks was also made by each observer after the observations and exchanges.

The result of each complete comparison is given in the following Table E.

Digitized by Google

TABLE E.—RESULTS of COMPARISONS of the CAPE HUT CLOCK with the CAPE TRANSIT CLOCK by Coincident Beats of Mean Time Chronometers transported between the Clocks.

Date.	1st Comparison.		2nd Comparison.		Mean.	
	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.
1881.	h m	s	h m	s	h m	s
April 9 - - -	8 51	+57·845	13 42	+57·720	11 17	+57·783+F_c
	8 53	·905	13 36	·710	11 15	·808+M_c
	8 53	·915	13 10	·815	11 2	·865+P_c
April 22 - -	9 56	+54·750	12 59	+54·830	11 28	+54·790+M_c
		·805	12 35	·890	11 17	·848+P_c
April 13 - -	—	—	—	—	9 16	+55·520+F_c
					9 18	·490+M_c
					8 44	·470+P_c
April 14 - -	8 50	+56·160	12 59	+56·245	10 55	+56·203+F_c
	9 18	·135	13 16	·200	11 17	·168+M_c
	8 57	·125	13 10	·265	11 4	·195+P_c
May 12 - - -	11 12	+22·395	15 19	+22·545	13 16	+22·470+F_c
	10 35	·410	14 59	·585	12 47	·498+M_c
	10 54	·390	14 56	·580	12 55	·485+P_c
May 20 - - -	11 3	+31·640	13 28	+31·740	12 16	+31·690+M_c
	10 49	·590	13 20	·765	12 5	·678+P_c
May 23 - - -	11 40	+35·750	15 55	+36·080	13 48	+35·915+M_c
	11 29	·785	15 36	·085	13 33	·935+P_c
June 16 - - -	12 5	+ 8·830	19 51	+ 9·155	15 58	+ 8·993+M_c
	12 5	·870	18 56	·163	15 31	9·017+P_c
June 17 - - -	12 13	+ 9·695	19 47	+ 9·895	16 0	+ 9·795+M_c
	12 3	·765	19 22	·985	15 42	·875+P_c
June 20 - - -	12 58	+12·635	19 4	+12·975	16 1	+12·805+M_c
	12 41	·645	18 40	·950	15 41	·798+P_c
June 21 - - -	12 22	+13·685	21 14	+14·065	16 48	+13·875+M_c
	12 36	·735	20 43	·040	16 40	·888+P_c
June 22 - - -	12 30	+14·710	19 2	+15·070	15 46	+14·890+M_c
	12 30	·730	18 36	·025	15 33	·878+P_c
June 27 - - -	12 35	+22·040	19 43	+22·450	16 9	+22·245+M_c
	12 48	·085	19 28	·490	16 8	·288+P_c
July 13 - - -	16 47	− 4·185	19 36	− 4·000	18 12	− 4·093+M_c
	16 46	·170	19 55	− 3·930	18 21	·050+P_c
August 18 - -	15 50	+17·335	17 50	+17·480	16 50	+17·408+P_c
	20 11	·650	22 20	+17·785	21 16	·718+P_c
August 19 - -	15 45	+18·965	22 18	+19·305	19 2	+19·135+P_c
August 25 - -	15 58	+30·445	17 20	+30·565	16 39	+30·505+P_c
August 26 - -	16 25	+32·850	17 17	+32·940	16 51	+32·895+P_c
	18 47	33·090	22 15	33·420	20 31	+33·255+P_c
August 27 - -	16 44	+35·320	18 44	+35·515	17 44	+35·418+P_c
	20 58	·770	21 59	+35·820	21 29	·795+P_c
August 28 - -	16 25	+37·580	17 42	+37·690	17 4	+37·635+P_c
	19 34	·850	22 20	38·065	20 57	·958+P_c

Digitized by Google

Date.	1st Comparison.		2nd Comparison.		Mean.	
	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.	Sidereal Time.	Hut Clock Slow of Transit Clock.
1881.	h m	s	h m	s	h m	s
September 3 - -	17 17	−11·800	21 58	−11·580	19 38	−11·690 + P_c
September 19 - -	18 19	+ 6·745	20 24	+ 6·835	19 21	+ 6·790 + P_c
	22 10	·920	23 45	6·960	22 58	·940 + P_c
December 23 - -	1 52	+ 4·805	8 53	+ 4·415	5 23	+ 4·610 + F_c
	2 43	·740	8 30	·455	5 37	·598 + P_c
December 29 - -	—	—	—	—	2 8	− 3·485 + F_c
					2 9	·500 + P_c
December 30 - -	3 23	− 5·205	7 0	− 5·455	5 12	− 5·330 + F_c
	3 9	·230	7 0	·440	5 5	·335 + P_c
1882.						
January 8 - -	4 39	−20·075	6 5	−20·195	5 22	−20·135 + P_c
January 14 - -	2 50	−29·510	6 56	−29·795	4 53	−29·653 + F_c
	2 49	·510	6 55	·825	4 52	·668 + P_c
January 17 - -	3 59	−35·605	7 7	−35·915	5 33	−35·760 + P_c
January 20 - -	3 32	−41·370	7 17	−41·650	5 25	−41·510 + F_c
	3 13	·340	7 29	·665	5 21	·503 + P_c
January 21 - -	3 56	+16·575	6 49	+16·295	5 23	+16·435 + P_c
January 26 - -	3 53	+ 5·210	6 30	+ 4·930	5 12	+ 5·070 + F_c
	4 29	·180	7 28	·845	5 59	·013 + P_c
January 27 - -	3 57	+ 2·635	8 4	+ 2·205	6 1	+ 2·420 + F_c
	5 3	·520	7 13	·280	6 8	·400 + P_c
February 13 - -	5 8	−35·800	9 1	−36·280	7 5	−36·040 + F_c
	5 4	·780	9 31	·265	7 18	·023 + M_c
	4 49	·780	8 58	·225	6 54	·003 + P_c
February 14 - -	5 2	−38·455	9 5	−38·980	7 3	−38·718 + F_c
	4 56	·455	8 56	·975	6 56	·715 + M_c
	4 45	·455	9 6	·950	6 56	·703 + P_c
February 15 - -	4 59	−40·970	8 59	−41·380	6 59	−41·175 + F_c
	4 52	·980	8 51	·415	6 52	·198 + M_c
	4 50	·975	8 52	·390	6 51	·183 + P_c
February 17 -	5 14	−45·855	9 19	−46·225	7 17	−46·040 + M_c
	5 0	·825	8 55	·180	6 58	·003 + P_c

From the results of Table E. we obtain the relative hourly rates of the Hut Clock to the Transit Clock during the observations. *See* Table F.

With these rates the comparisons of the different observers have been reduced to the same epoch, and we obtain the personal equation of the different observers in comparing the clocks in question as follows:—

Taking Mr. Pett as standard, that is, putting $P_c = 0$, we get—

$F_c = +0^{sec.}\cdot003$, with a probable error of $\pm{}^{sec.}\cdot004$ from 15 comparisons.

$M_c = +\ \cdot021$, „ „ $\pm\ \cdot005$ „ 18 „

The probable error of a single complete comparison is with—

$F_c \pm 0^{sec.}\cdot016$

$M_c \pm\ \cdot020$.

Digitized by Google

Now *à priori* one would suppose it impossible that personal equation could exist in comparing two sidereal clocks with the intervention of a mean time chronometer, because, if the observer acquired a systematic habit of waiting too long for the coincidence, or *vice versâ*, that habit would probably be the same for both clocks. But it happens, in the present case, that the clocks under comparison have very different beats, that of the Transit Clock being very loud, and that of the Hut Clock quiet but sharp, and the observations give pretty certain proof that this circumstance has produced real personality. Between Finlay and Pett there is, as I should have expected, no sign of relative personal equation; of their 15 comparisons eight give a positive and seven a negative value for F_c. In the case of Maclear 13 comparisons give positive values and five negative values (the latter all very small) of M_c. We must, therefore, regard the difference in Maclear's case as real, and due to the fact that his sense of hearing is by no means so acute as that of Finlay and Pett, and I can conceive that the very marked difference in the character of the beats of the two clocks may have thus systematically affected Maclear's comparisons. I, therefore, regard Finlay and Pett as normal observers, unaffected by personality in such comparisons, but that Maclear's determinations of "Hut Clock slow on Transit Clock" require the correction + 0^s·020. That is, for the combinations which occur in Table E, the corrections to "Hut Clock slow of Transit Clock" will be—

$$\frac{F_c + M_c + P_c}{3} = \overset{\text{sec.}}{+ 0{\cdot}007}.$$

$$\frac{F_c + P_c}{2} = \quad {\cdot}000.$$

$$\frac{M_c + P_c}{2} = \quad {\cdot}010.$$

$$P_c = \quad {\cdot}000.$$

Applying these corrections to the mean results of Table E., we get the following errors of the Cape Hut Clock on the Transit Clock at the mean epoch of the comparisons :—

TABLE F.—DEFINITIVE ERRORS of the CAPE HUT CLOCK relative to the TRANSIT CLOCK.

Date.	Sidereal Time.	Hut Clock slow of Transit Clock.	Relative Hourly Rates of Hut Clock slow on Transit Clock from Comparisons on same Night.
1881.	h m	s	s
April 9 - -	11 11	+57·826	−·030
12 - -	11 22·5	+54·829	+·030
13 - -	9 6	+55·500	[+·027]
14 - -	11 5	+56·196	+·024
May 12 - -	12 59	+22·491	+·041
20 - -	12 10·5	+31·694	+·055
23 - -	13 40·5	+35·935	+·076
June 16 - -	15 44·5	+ 9·015	+·043
17 - -	15 51	+ 9·845	+·029

Digitized by Google

Date.	Sidereal Time.	Hut Clock slow of Transit Clock.	Relative Hourly Rates of Hut Clock slow on Transit Clock from Comparisons on same Night.
1881.	h m	s	s
June 20 - -	15 51	+12·812	+·054
21 - -	16 44	+13·892	+·041
22 - -	15 39·5	+14·894	+·052
27 - -	16 8·5	+22·277	+·060
July 13 - -	18 16·5	− 4·082	+·071
Aug. 18 - -	19 3	+17·563	+·069
19 - -	19 2	+19·135	+·053
25 - -	16 39	+30·505	+·088
26 - -	18 41	+33·075	+·096
27 - -	19 36·5	+35·607	+·100
28 - -	19 0·5	+37·797	+·083
Sept. 3 - -	19 38	−11·690	+·047
19 - -	21 9·5	+ 6·865	+·041
Dec. 23 - -	5 30	+ 4·604	−·053
29 - -	2 8·5	− 3·493	[−·059]
30 - -	5 8·5	− 5·333	−·062
1882.			
Jan. 8 - -	5 22	−20·135	[−·068]
14 - -	4 52·5	−29·661	−·073
17 - -	5 33	−35·760	−·098
20 - -	5 23	−41·507	−·074
21 - -	5 23	+16·435	−·096
26 - -	5 35·5	+ 5·042	−·111
27 - -	6 4·5	+ 2·410	−·107
Feb. 13 - -	7 6	−36·029	−·114
14 - -	6 58	−38·719	−·125
15 - -	6 54	−41·192	−·105
17 - -	7 7·5	−46·032	−·092

Digitized by Google

CHAPTER V.

FORMATION OF DEFINITIVE CLOCK ERRORS AND RATES.

The Cape Hut Clock.

To determine definitively the rate of the Cape Transit Clock at the various times of observation, the following table has been prepared.

The column marked R_d is the hourly rate as it is usually deduced, viz., by taking for a particular night the mean hourly rate derived from observations on the preceding and following night. In deducing these rates, the personal equation of the observers has been taken into account, and when observations have not been secured for purposes of the longitude on successive days the rates of column R_d are taken from the Observatory Clock Book as deduced from the routine observations.

Columns R_p and R_i give the hourly rate derived from observations of the same night by the observers P and I respectively.

Column R_n gives the definitive rate deduced by combining the observations of P and I, weight being given to the separate results in proportion to the square of the interval between the first and second time determinations of each observer.

Column ϵ_n gives the *mean error* of the determination of the clock rate on each night.

Column $R_n - R_d$ gives the correction which the results for clock hourly rates reckoned from day to day require to reduce them to the hourly rate during the night.

The values of ϵ_n may be deduced by various methods.

(1.) From the discordance of the clock errors determined by the two observers on the same night, allowance being made for their difference of personal equation.

(2.) From the discordance of the separate clock errors derived from the different time stars observed by the same observer.

(3.) From the discordance of the clock rates determined by the two observers.

The *first* of these methods is liable to the objection that, although the personal equation remains pretty constant during one night, it somewhat varies from night to night, and we should probably arrive at too small a value of ϵ_n. By the *second* method we should probably arrive at too small a value of ϵ, because a sensible part of the error of determination of Azimuth, Level and Collimation will remain common to all the stars. The *third* method, though more troublesome, is free from these objections; I have, therefore, employed it as follows. Put—

ϵ = the *mean error* of a normal time determination (*i.e.*, from four time stars with independent determinations of Azimuth, Level and Collimation).

t = the number of hours between the epochs of first and second time determination of the same observer on the same night.

m = the discordance between the clock rates determined by two observers.

Digitized by Google

Then the *mean error* of the hourly rate of a clock derived from two such time determinations, an hour apart, by one observer is—

$$\pm \sqrt{2}\,\epsilon,$$

or, if the interval between the observations is t hours, the *mean error* of the rate is—

$$\pm \frac{\sqrt{2}\,\epsilon}{t}.$$

Hence, if there are two observers whose mean errors for a time determination are $\epsilon_{,}$ and $\epsilon_{,,}$, and if they have both determined the rate of the same clock for the same epoch, each by two time determinations, separated by $t_{,}$ and $t_{,,}$ hours, we have in the mean—

$$\frac{2\epsilon_{,}^{2}}{t_{,}^{2}} + \frac{2\epsilon_{,,}^{2}}{t_{,,}^{2}} = m^2,$$

and if we put $\epsilon_{,}^{2} = \epsilon_{,,}^{2}$, which is practically true for Pett and Freeman, we have—

$$\epsilon^2 = \frac{1}{2} m^2 \frac{t_{,}^{2}\, t_{,,}^{2}}{t_{,}^{2} + t_{,,}^{2}},$$

of which the weight of each equation is $(t_{,}^{2} \div t_{,,}^{2})$; whence in the usual notation of least squares—

$$\left[(t_{,}^{2} + t_{,,}^{2})\,\epsilon^2\right] = \left[\frac{1}{2} m^2 \,.\, t_{,}^{2}\, t_{,,}^{2}\right] \quad \text{- - - - - - - - -} \quad (1),$$

and the theoretical *mean error* of each observed clock rate is for two observers—

$$\left.\begin{aligned} \epsilon_{n} &= \frac{\epsilon}{t_0}, \\ \text{where } t_0 &= \sqrt{t_{,}^{2} + t_{,,}^{2}}, \end{aligned}\right\} \quad \text{- - - - - - - - - - - -} \quad (2).$$

By application of Equation (1) to the data of Table A., I find—

$$\epsilon = \pm 0^{\text{sec.}}\cdot 031,$$

or, taking the table in four separate groups, we have—

For Group	I.	$\epsilon = \pm$ sec. ·030.
„	II.	$= \pm$ ·029.
„	III.	$= \pm$ ·030.
„	IV.	$= \pm$ ·034.

These quantities are practically identical, and show the constancy of the quality of the observers' work; and also that the *probable error* of a time determination by four stars with the Cape Transit Circle, including also the error of the star places and the errors of the determination of the instrumental constants, is for Pett and Freeman $= \pm 0^{s}\cdot 021$.

Digitized by Google

Rates of the Cape Transit Clock.

Note.—(The length of the pendulum was altered in October.)

		R_d.	R_p.	R_l.	R_n.	$R_n - R_d$.	ϵ_n.
	1881.	s	s	s	s	s	s
Group I.	April 9	−·039	−·050	−·017	−·044	−·005	±·017
	April 12	−·034					
	April 13	−·033	−·100		−·100	−·067	·056
	April 14	−·036	−·063	−·063	−·063	−·027	·016
	May 12	−·042	−·053	−·072	−·058	−·016	·016
	May 20	−·044	−·063		−·063	−·019	·040
	May 23	−·046	−·018	−·064	−·060	−·014	·016
Group II.	June 16	−·036	−·057	−·069	−·062	−·026	·007
	June 17	−·037	−·046	−·016	−·037	·000	·007
	June 20	−·034	−·015	−·004	−·011	+·023	·008
	June 21	−·033	−·025	−·020	−·023	+·010	·005
	June 22	−·032	−·060	−·060	−·060	−·028	·008
	June 27	−·038	−·051	−·056	−·053	−·015	·008
Group III.	August 18	−·038	−·025	−·056	−·033	+·003	·008
	August 19	−·040	−·026	−·032	−·028	+·012	·006
	August 25	−·037	−·027	−·032	−·029	+·008	·009
	August 26	−·042	−·040	−·051	−·043	−·001	·008
	August 27	−·049	−·044	−·053	−·046	+·003	·008
	August 28	−·044	−·040	−·067	−·045	−·001	·007
	September 3	−·046	−·045		−·045	+·001	·008
	September 19	−·035	−·038	−·021	−·035	·000	·008
Group IV.	December 23	+·023	+·027	+·048	+·033	+·010	·006
	December 29	+·018					
	December 30	+·018	+·036		+·036	+·018	·016
	1882.						
	January 8	+·017					
	January 9	+0·17					
	January 14	+0·15					
	January 17	+·013	+·012		−·012	+·001	·013
	January 20	+·015	−·015		−·015	−·030	·017
	January 21	+·011	+·010	+·003	+·009	−·002	·016
	January 26	+·011					

Digitized by Google

Rates of the Cape Transit Clock—*cont.*

NOTE.—(The length of the pendulum was altered in October.)

		R_d.	R_p.	R_i.	R_n.	$R_n - R_d$.	ϵ_n.
	1882.	s	s	s	s	s	s
Group IV.—*cont.*	January 27 - -	+·013					
	January 28 - -	+·015					
	February 13 - -	+·015	+·034	−·006	+·030	+·015	±·015
	February 14 - -	+·015	+·032	−·035	+·024	+·009	·014
	February 15 - -	+·016	+·002	−·007	−·006	−·022	·014
	February 17 - -	+·017	+·048	+·039	+·040	+·023	·015

Giving to the separate values of $R_n - R_d$ the weights $\frac{1}{\epsilon_n^2}$ from the above table, we find that the correction of the rate reckoned from day to day to reduce it to the rate determined from the observations at night amounts in the mean to—

$$+ 0^{\text{sec.}}0016,$$

a quantity totally insignificant.

If we divide the results into four groups, we obtain the like corrections as in Column I. of the following Table:—

	I. Correction of Daily Rate.	II. Mean Value of $(R_n - R_d)^2$.	III. Mean Value of ϵ_n^2.	IV. Mean Daily Range of Temperature.	V. Correction of Temperature at 10^h to Mean Daily Temperature.
	s			°	°
Group I. - - -	−·016	·001026	·000966	8·6 F.	+2·2 F.
Group II. - - -	·000	386	53	8·2	+1·1
Group III. - - -	+·004	29	61	8·0	+1·5
Group IV. - - -	+·005	294	205	10·3	+2·8

We have now to consider, with the evidence of Columns II. and III., and also having regard to the temperature conditions given in Columns IV. and V., whether the corrections given in Column I. are real or apparent.

If the quantities of Column II. were systematically greater than those of Column III., we should have evidence that the rates determined from the observations at night are systematically more reliable than those from the daily rate; but in Groups II. and III., which have by far the greatest weight, the evidence is contradictory, nor is it by any means pronounced in Groups I. and IV. We also see from the comparison of the apparent systematic corrections with the temperature conditions that there is no cause to account for the discordant values of Column I.; those corrections may therefore be considered as due merely to accidental errors of observation.

Digitized by Google

The conclusion is that the rate of the Cape Transit Circle clock is not sensibly affected by change of temperature, and we shall therefore derive a more accurate value of its rate by adopting that obtained from the observations of one day and the next than by employing that derived from observations of the same night.

The definitive rate of the Transit Clock by night or day is therefore to be taken from the column R_d of the preceding Table.

The relative rate of the Hut Clock to the Transit Clock given in Table F., applied to the rate R_d, gives the hourly rate of the Hut Clock. See Column V. of the Table G.

Column II. of Table G. gives the errors of the Cape Hut Clock from observations with the Transit Circle combined with Chronometer Comparisons of the clocks (*i.e.*, combining the results of Table A. and Table F.).

Column III. gives the errors of the same clock, derived from observations with the Hut Transit, the results being corrected by $-^s\cdot028$ to reduce to the longitude of the Transit Circle.

The mean hourly rate from day to day given in Column IV. has been obtained by combining the determinations by both instruments with equal weight, and correcting for the personal equation of the observers by approximately known values of F′, M′, P, and I.

The rates of Column V. have been adopted as definitive.

TABLE G.—DEFINITIVE ERRORS and HOURLY RATES of the CAPE HUT CLOCK.

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
1881.	h m	s	s	s	s
April 9	11 16	$-31\cdot321 + \frac{P}{2} + \frac{I}{2}$	$-31\cdot568 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot069$
„ 13	10 30	$-36\cdot863 + I$	$-37\cdot073 + M'$		$-\cdot006$
„ 14	11 14	$-37\cdot178 + \frac{P}{2} + \frac{I}{2}$	$-37\cdot367 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot012$
May 12	13 5	$-34\cdot968 + \frac{P}{2} + \frac{I}{2}$	$-35\cdot103 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot001$
„ 20	12 26	$-33\cdot790 + P$	$-33\cdot853 + M'$	$+\cdot007$	$+\cdot011$
„ 23	13 33	$-32\cdot689 + \frac{P}{2} + \frac{I}{2}$	$-32\cdot806 + \frac{F'}{2} + \frac{M'}{2}$	$+\cdot014$	$+\cdot030$
June 16	16 12	$-23\cdot071 + \frac{P}{2} + \frac{I}{2}$	$-23\cdot146 + M'$	$-\cdot002$	$+\cdot007$
„ 17	15 36	$-23\cdot140 + \frac{P}{2} + \frac{I}{2}$	$-23\cdot166 + M'$	$+\cdot005$	$-\cdot008$
„ 20	15 45	$-22\cdot814 + \frac{P}{2} + \frac{I}{2}$	$-22\cdot763 + M'$	$+\cdot009$	$+\cdot020$

Digitized by Google

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
				s	s
1881. June 21	h m 17 8	s $-22\cdot495 + \frac{P}{2} + \frac{I}{2}$	s $-22\cdot613 + M'$		$+\cdot008$
				$+\cdot010$	
„ 22	15 47	$-22\cdot276 + \frac{P}{2} + \frac{I}{2}$	$-22\cdot376 + M'$		$+\cdot020$
				$+\cdot019$	
„ 27	15 58	$-20\cdot034 + \frac{P}{2} + \frac{I}{2}$	$-20\cdot093 + M'$		$+\cdot022$
Aug. 18	18 54	$-14\cdot868 + \frac{P}{2} + \frac{I}{2}$			$+\cdot031$
				$+\cdot027$	
„ 19	19 23	$-14\cdot213 + \frac{P}{2} + \frac{I}{2}$			$+\cdot013$
				$+\cdot035$	
„ 25	19 4	$-9\cdot185 + \frac{P}{2} + \frac{I}{2}$			$+\cdot051$
				$+\cdot104$	
„ 26	19 15	$-6\cdot666 + \frac{P}{2} + \frac{I}{2}$			$+\cdot054$
				$+\cdot055$	
„ 27	19 13	$-5\cdot352 + \frac{P}{2} + \frac{I}{2}$			$+\cdot051$
				$+\cdot044$	
„ 28	19 15	$-4\cdot304 + \frac{P}{2} + \frac{I}{2}$			$+\cdot039$
				$+\cdot032$	
Sept. 3	19 47	$-59\cdot630 + P$			$+\cdot001$
				$+\cdot007$	
„ 19	20 43	$-56\cdot789 + \frac{P}{2} + \frac{I}{2}$			$+\cdot006$
Dec. 23	5 30	$-35\cdot950 + \frac{P}{2} + \frac{I}{2}$	$-36\cdot231 + F'$		$-\cdot030$
				$-\cdot039$	
„ 29	3 6	$-41\cdot463 + \frac{P}{2} + \frac{I}{2}$			$-\cdot041$
				$-\cdot011$	
„ 30	5 12	$-42\cdot908 + P$	$-42\cdot893 + F'$		$-\cdot044$
				$-\cdot052$	
1882. Jan. 8	5 22	$-54\cdot053 + P$			$-\cdot051$
„ 14	3 32	$-61\cdot264 + P$			$-\cdot058$
				$-\cdot069$	
„ 17	5 19	$-66\cdot452 + P$	$-66\cdot458 + F'$		$-\cdot085$
				$-\cdot066$	
„ 20	5 38	$-71\cdot184 + P$	$-71\cdot283 + F'$		$-\cdot059$
				$-\cdot073$	
„ 21	5 8	$-12\cdot781 + \frac{P}{2} + \frac{I}{2}$			$-\cdot085$
				$-\cdot081$	
„ 26	5 8	$-22\cdot633 + P$	$-22\cdot723 + F'$		$-\cdot100$
				$-\cdot096$	
„ 27	5 22	$-25\cdot015 + P$	$-25\cdot003 + F'$		$-\cdot094$
				$-\cdot080$	

Digitized by Google

Date.	I. Sidereal Time.	II. Clock Slow from Observations with the Transit Circle. Δt	III. Clock Slow from Observations with the Hut Transit. Δt	IV. Hourly Rates. Day to Day.	V. Hourly Rates. From the Chronometer Comparisons.
				s	s
1882. Feb. 13	h m 7 0	$-57^{s}\cdot819 + \frac{P}{2} + \frac{I}{2}$	$-57^{s}\cdot956 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot099$
				$-\cdot098$	
„ 14	7 0	$-60\cdot167 + \frac{P}{2} + \frac{I}{2}$	$-60\cdot333 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot110$
				$-\cdot088$	
„ 15	7 0	$-62\cdot292 + \frac{P}{2} + \frac{I}{2}$	$-62\cdot448 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot089$
				$-\cdot083$	
„ 17	7 0	$-66\cdot290 + \frac{P}{2} + \frac{I}{2}$	$-66\cdot431 + \frac{F'}{2} + \frac{M'}{2}$		$-\cdot075$
July 10	17 36		$-78\cdot734 + F'$		$-\cdot030$ (1)
„ 13	17 27		$-82\cdot512 + F'$		$-\cdot037$ (1)

(1) These rates are deduced from the earlier and later sets of observations on the same night.

The Durban Clock.

The following Table H. contains the results of such time determinations at Durban as enter into the Longitude Operations.

A comparison of the rates reckoned from day to day with those derived from observations of the same night shows no systematic difference, the accidental differences being within the limits of the probable errors of their determination.

The compensation of the pendulum for the effect of temperature seems therefore to be sensibly exact.

With the mercurial compensation pendulum there is a tendency, on a sudden change of temperature, for the rod to acquire the new temperature more quickly than the large mass of mercury which forms the pendulum bob.

Thus a sudden fall of temperature causes the clock to gain until the mercury of the bob acquires the same temperature as the rod. But in Dent's pendulum in question the zinc cylinder and steel rod appear to acquire heat at the same rate, and thus the compensation is preserved even under the great changes of temperature to which a clock placed in a wooden hut under a tropical sun is subjected.

Digitized by Google

TABLE H.—ERRORS and HOURLY RATES of the DURBAN CLOCK.

Date.		Sidereal Time.	Clock Slow.	Hourly Rates reckoned from Day to Day.	Hourly Rate from Observations of the same Night.	Adopted Hourly Rate.
		h m	s	s		
June	16	9 15	$-32\cdot420 + F'$	$-\cdot411$		
„	17 [a]	13 50	$-32\cdot243 + F'$		$-\cdot440$ [1]	$-\cdot425$
„	21 [b]	11 22	$-35\cdot813 + F'$		$-\cdot075$	$-\cdot075$
„	22 [c]	10 13	$-37\cdot828 + F'$		$+\cdot139$	$+\cdot139$
„	24	8 15	$-34\cdot665 + F'$			$+\cdot036$
„	27	8 53	$-32\cdot005 + F'$	$+\cdot036$		
August	18	10 4	$-28\cdot953 + M'$		$+\cdot089$	$+\cdot060$
„	19	10 16	$-27\cdot605 + M'$	$+\cdot056$	$+\cdot048$	$+\cdot054$
„	20	9 52	$-26\cdot380 + M'$	$+\cdot052$	$+\cdot041$	$+\cdot048$
„	23	9 44	$-23\cdot175 + M'$	$+\cdot043$	$+\cdot069$	$+\cdot044$
„	29	9 25	$-13\cdot280 + M'$	$+\cdot045$	$+\cdot057$	$+\cdot045$
September	2	7 8	$-\ 9\cdot153 + M'$	$+\cdot044$		$+\cdot045$
„	13	7 26	$-58\cdot085 + M'$	$+\cdot045$		$+\cdot050$
„	18	7 18	$-51\cdot630 + M'$	$+\cdot054$		$+\cdot044$
„	19	10 22	$-50\cdot675 + M'$	$+\cdot035$	$+\cdot041$	$+\cdot045$
„	22	10 13	$-46\cdot666 + M'$	$+\cdot056$	$+\cdot071$	$+\cdot056$
„	23	9 39	$-45\cdot379 + M'$	$+\cdot055$	$+\cdot018$	$+\cdot055$
„	26	10 21	$-41\cdot421 + M'$	$+\cdot054$	$+\cdot041$	$+\cdot050$
„	28	7 12	$-39\cdot355 + M'$	$+\cdot046$		$+\cdot046$
November	20	11 14	$-49\cdot414 + \frac{F'}{2} + \frac{M'}{2}$			$+\cdot035$
„	21	13 29	$-48\cdot896 + \frac{F'}{2} + \frac{M'}{2}$	$+\cdot020$		$+\cdot030$
„	26 [2]	12 10	$-43\cdot249 + \frac{F'}{2} + \frac{M'}{2}$	$+\cdot046$		$+\cdot045$
„	27 [2]	10 46	$-42\cdot422 + \frac{F'}{2} + \frac{M'}{2}$			$+\cdot045$
December	23	11 50	$-21\cdot660 + M'$	$+\cdot022$	$+\cdot032$	$+\cdot030$

(1) From Obs. Lamp E. only before Sigs. combined with the Obs. Lamp E. after Sigs. (interval $5^h\ 25^m$).

(2) On Nov. 26 both F. and M. observed all the Stars with Lamp East, and on Nov. 27 all Stars Lamp W. It is necessary to combine these results, as, for some reason which I cannot explain, both observers appear to make systematic errors in opposite directions in the two positions of this instrument.

(a) Pendulum lengthened $12\frac{1}{2}$ divisions on June 17.
(b) „ „ $5\frac{1}{2}$ „ „ 21.
(c) „ shortened 3 „ „ 23.

Digitized by Google

Date.		Sidereal Time.	Clock Slow.	Hourly Rates reckoned from Day to Day.	Hourly Rate from Observations of the same Night.	Adopted Hourly Rate.
1882.		h m	s	s	s	s
January	8	16 27	−13·595 + M′			+ ·022
				+ ·023		
„	14	10 32	−10·410 + M′			+ ·023
				+ ·023		
„	20	16 37	− 6·940 + M′			+ ·018
				+ ·013		
„	21	10 29	− 6·712 + M′			+ ·010
				+ ·006		
„	27	11 10	− 5·905 + M′		+ ·022	+ ·010
July	10	10 22	−45·557 + P′		+ ·048	+ ·052
				+ ·057		
„	13	10 19	−41·432 + P′		+ ·036	+ ·050

The Aden Clock.

This clock is in every respect similar with the Durban Clock.

The following Table I. contains the results of such time determinations at Aden as enter into the Longitude operations.

A comparison of the hourly rates, reckoned from day to day, with those derived from observations of the same night shows a systematic difference of + 0ˢ·007, by which amount the rates reckoned from day to day have to be corrected.

In other words, the pendulum is very slightly over-compensated, and for the change of temperature by day and night which obtains at Aden in the month of September the hourly rate of the clock is slower by 0ˢ·007 during the observations at night than is the rate for the day.

The adopted hourly rates have therefore been obtained by applying a correction of +0ˢ·007 to the hourly rates obtained from the observations of one day and the next.

Digitized by Google

TABLE I.—ERRORS and HOURLY RATES of the ADEN CLOCK.

Date.	Sidereal Time.	Clock Slow.	Hourly Rate from Day to Day.	Hourly Rates from Observations of the Same Night.	Adopted Hourly Rate.
	h m	s	s	s	s
August 20 - -	18 27·5	− 4·710 + F′			−·638
			−·645		
21 - -	19 31	−20·900 + F′			−·636
			−·643		
23 - -	19 31	−51·750 + F′			−·636
Altered length of the pendulum.					
26 - -	22 4	−37·050 + F′		−·071	−·074
			−·081		
27 - -	20 7	−38·830 + F′			−·073
			−·078		
29 - -	21 18	−42·655 + F′		−·071	−·070
			−·076		
September 2 -	22 20	−50·035 + F′			−·070
			−·078		
3 -	23 55	−52·025 − F′			−·071
Lengthened pendulum 2 divisions of screw-head.					
13 -	20 32	−46·345 + F′	+·008		+·015
15 -	22 30	−45·930 + F′			+·016
			+·009		
18 -	23 44	−45·283 + F′		+·030	+·017
			+·010		
19 -	0 12	−45·043 + F′		+·011	+·015
			+·005		
22 -	21 18	−44·670 + F′			+·016
			+·012		
23 -	23 47	−44·358 + F′		+·011	+·017
			+·009		
24 -	22 5	−44·155 + F′			+·013
			+·004		
25 -	22 35	−44·065 + F′			+·014
			+·009		
26 -	21 42	−43·850 + F′			+·015
			+·008		
27 -	21 47	−43·670 + F′			+·015
			+·008		
28 -	0 46	−43·442 + F′		+·010	+·015

Digitized by Google

CHAPTER VI.

EXCHANGE OF SIGNALS.

Two kinds of signals have been employed; those exchanged between the Cape and Durban being audible signals, sent on land lines, those between Aden and Durban being mirror signals, sent through submarine cables.

A description of the instruments and methods employed in sending and receiving these signals is given in Chapter III. From that description it is evidently not necessary to tabulate all the signals exchanged, but only to give the clock times at which the clock beats at both stations were *apparently* in coincidence.

Thus in the following Table I., which gives these clock times of *apparent* coincidence of the clock beats at the Cape and Durban, Maclear is supposed to send signals in exact coincidence with each tenth beat of the Cape Hut Clock. These beats are repeated by the "Sounder" at Durban, and at $10^h\ 38^m\ 17^s$ the beat of this Sounder is found by Finlay to coincide with the beat of his clock at Durban. On after-comparison of the records of both stations, giving the times of first and last signals and of the omitted signal, the corresponding signal ($15^h\ 32^m\ 40^s$) is easily identified. But the beat of the Sounder at Durban does not represent the beat of the Cape Clock, but the time of this beat, *plus* the time of transmission of the signal, which we shall call θ; therefore, in estimating the true clock times of true coincidence of the clock beats, we have to write, when signals are sent from the Cape,—

$$\text{Cape Clock time} + \theta = \text{Durban Clock time.}$$

To reduce these to corresponding local times, we apply to the Cape Clock the correction $(\Delta t + \frac{P}{2} + \frac{I}{2} + \textit{correction for rate})$ from Columns II. and V. of Table G., or of $(\Delta t + M' + \textit{correction for rate})$ from Columns III. and V. of the same Table, and convert from Sidereal into Cape Mean Time. We must also apply the symbolical correction $+ M_s$ for the personal error of Maclear in sending signals. The Durban clock time must receive the correction $(\Delta t + F')$ from Table H., and the further symbolical correction F_r for the personal equation of Finlay in receiving audible signals. The observed difference of Longitude, $\Delta\lambda$, (taking the Cape as origin,) will therefore be—

$$\Delta\lambda = T_w + \theta + \frac{P}{2} + \frac{I}{2} + M_s - (T_c + F' + F_r),$$

where the errors of the Cape Hut Clock have been determined from the data of Table G., Column II., and where T_w and T_c are the numerically corrected clock mean times at the Western and Eastern Stations respectively.

Digitized by Google

Similarly, when signals are sent from Durban to the Cape, we have

$$\Delta\lambda = T_w + \frac{P}{2} + \frac{I}{2} + M_r - (T_e + \theta + F' + F_s),$$

or putting

$\Delta T_w = T_w - T_e$ when signals are sent from the Western and received at the Eastern station,

$\Delta T_e = T_w - T_e$ „ „ „ Eastern „ „ Western station,

we get

$$\Delta\lambda - \theta = \Delta T_w - F' + \frac{P}{2} + \frac{I}{2} - F_r + M_s,$$

$$\Delta\lambda + \theta = \Delta T_e - F + \frac{P}{2} + \frac{I}{2} - F_s + M_r;$$

whence

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} - F' + \frac{P}{2} + \frac{I}{2} - \frac{F_r + F_s}{2} + \frac{M_r + M_s}{2},$$

$$\theta = \frac{\Delta T_e - \Delta T_w}{2} + \frac{F_r - F_s}{2} + \frac{M_r - M_s}{2};$$

or, if we take the clock errors at the Cape from the determinations of clock error with the Hut Transit; that is, use Column III. of Table G. instead of Column II. of same Table, we have

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} - F' + M' - \frac{F_r + F_s}{2} + \frac{M_r + M_s}{2}.$$

In the following Table I. the values of ΔT_w and ΔT_e have been computed with the errors of the Hut Clock as determined by the Transit Circle and chronometer comparison of the two clocks.

To find the numerical values of ΔT_w and ΔT_e in the case where the clock error at the Cape is determined with the Hut Transit, it is only necessary to apply to each a correction $(= \Delta t_{III} - \Delta t_{II})$ where these expressions represent the values of Δt taken from Columns III. and II. respectively of Table G.

TABLE I.—CLOCK TIMES of *apparent* coincidence of BEATS of the CLOCKS at the CAPE and DURBAN, from SIGNALS exchanged between FINLAY at DURBAN and MACLEAR at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s	h m s	m s	h m s	h m s	m s
June 17 - -	15 32 40	= 10 38 17	−5o 12·17	15 43 25	= 10 49 0	−5o 11·85
	16 4 30	= 11 10 2	12·15	49 51	= 10 55 25	11·86
				56 17	= 11 1 5o	11·88
June 21 - -	17 28 30	= 12 17 58	−5o 12·14	17 38 29	= 12 27 55	−5o 11·77
	53 5o	= 12 43 14	12·27	44 25	= 12 33 5o	11·73
	59 35	= 12 48 58	12·20	5o 26	= 12 39 5o	11·71
June 22 - -	15 39 10	= 10 25 2	−5o 12·00	15 49 40	= 10 35 30	−5o 11·75
	16 3 35	= 10 49 23	12·06	55 26	= 10 41 15	11·70
	16 9 25	= 10 55 12	11·98			
June 27 - -	15 32 30	= 9 58 40	−5o 12·05	15 37 1	= 10 3 10	−5o 11·82
	16 21 0	= 10 47 2	12·04	15 43 22	= 10 9 30	11·86
				16 7 36	= 10 33 40	11·83
				16 13 47	= 10 39 5o	11·85

Digitized by Google

In the following Table II. are similarly given the results of signals exchanged between Maclear at Durban and Pett at the Cape. The time determinations at the Cape depend entirely on the Transit Circle (Table G.), those at Durban on the results of Table F. The separate results for $\Delta\lambda$ will therefore be computed from this Table by the expression—

$$\Delta\lambda = \frac{\Delta T_w + \Delta T_e}{2} + \frac{P}{2} + \frac{I}{2} - M' + \frac{P_r + P_s}{2} - \frac{M_r + M_s}{2},$$

$$\text{and } \theta = \frac{\Delta T_e - \Delta T_w}{2} + \frac{P_r - P_s}{2} - \frac{M_r - M_s}{2}.$$

TABLE II.—CLOCK TIMES of *apparent* coincidence of BEATS of the CLOCKS at the CAPE and DURBAN from SIGNALS exchanged between MACLEAR at DURBAN and PETT at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_e.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
	h m s = h m s		m s	h m s = h m s		m s
August 18 -	19 30 40 = 10 31 46		−5o 12·31	10 23 55 = 19 22 48		−5o 12·01
	19 36 50 = 10 37 55		12·31	10 48 15 = 19 47 12		12·01
August 19 -	20 9 25 = 11 6 28		−5o 12·27	10 58 5 = 20 1 1		−5o 11·88
	20 15 20 = 11 12 22		12·24	11 22 30 = 20 25 30		11·93
	20 21 30 = 11 18 31		12·26	11 28 30 = 20 31 31		11·91
September 19 -	21 26 50 = 10 21 28		−5o 12·43	10 11 40 = 21 17 1		−5o 11·83
	21 33 10 = 10 27 47		12·47	10 47 50 = 21 53 17		11·78

The following Table III. gives similar results of signals exchanged between Finlay at the Cape and Maclear at Durban. The error of the Cape Hut Clock on each of the six nights has been determined by observations with the Transit Circle and chronometer comparisons of that Clock with the Hut Clock; the values of ΔT_w and ΔT_e, given in Table III., have been computed with these results.

On December 23, January 20, and January 27, the error of the Hut Clock was also determined by Finlay with the Hut Transit, but the effects of a recurring fever which had attacked Mr. Finlay during his absence on the East Coast of Africa rendered him physically unfit to observe on the other three nights in question.

The values of ΔT_w and ΔT_e resulting from Finlay's observations may be obtained, as before, by application of the correction $(\Delta t_{III} - \Delta t_{II})$ to the corresponding values of Δt in Table G.

The symbolical corrections for personal equation applicable to these results will be evident from what has been previously said, and they are afterwards given in Table .

Digitized by Google

TABLE III.—CLOCK TIMES of *apparent* COINCIDENCE of BEATS of the CLOCKS at the CAPE and DURBAN from SIGNALS exchanged between MACLEAR at DURBAN and FINLAY at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_c.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
1881.	h m s = h m s		m s	h m s = h m s		m s
December 23 -	6 5 50 = 12 45 23		−5o 12·11	6 15 24 = 12 54 55		−5o 11·68
	6 30 20 = 13 9 49		12·14	6 21 45 = 13 1 15		11·73
1882.						
January 8 -	4 58 15 = 10 34 39		−5o 12·54	5 7 48 = 10 44 10		−5o 12·12
	5 22 25 = 10 58 45		12·52	5 13 44 = 10 50 5		12·09
January 14 -	4 49 45 = 10 2 24		−5o 12·21	4 59 33 = 10 12 10		−5o 11·83
	5 14 5 = 10 26 40		12·23	5 5 39 = 10 18 15		11·84
January 20 -	5 35 20 = 10 24 3		−5o 12·33	5 51 20 = 10 40 0		−5o 11·97
	5 41 45 = 10 30 27		12·39	5 57 31 = 10 46 10		11·99
	6 11 50 = 11 0 27		12·36	6 3 22 = 10 52 0		11·96
January 21 -	5 40 25 = 10 26 9		−5o 12·22	5 50 28 = 10 36 10		−5o 11·87
	6 4 30 = 10 50 10		12·19	5 56 24 = 10 42 5		11·85
January 27 -	6 15 45 = 10 37 35		−5o 12·49	6 25 27 = 10 47 15		−5o 12·11
	6 21 40 = 10 43 29		12·48	6 31 33 = 10 53 20		12·12
	6 45 50 = 11 7 35		12·48	6 37 34 = 10 59 20		12·12

The following signals were exchanged between Pett at Durban and Finlay at the Cape. The time was determined at both stations with the Hut Transits.

TABLE IV.—CLOCK TIMES of *apparent* COINCIDENCE of BEATS of the CLOCKS at the CAPE and DURBAN from SIGNALS exchanged between PETT at DURBAN and FINLAY at the CAPE.

Date.	Cape Sending.		ΔT_w.	Durban Sending.		ΔT_c.
	Cape Hut Sid. Clock.	Durban M.T. Clock.		Cape Hut Sid. Clock.	Durban M.T. Clock.	
1882.	h m s = h m s		m s	h m s = h m s		m s
July 10 - -	17 14 45 = 10 49 44		−5o 12·35	17 24 33 = 10 59 30		−5o 11·98
	17 20 40 = 10 55 38		12·34	17 30 29 = 11 5 25		11·96
	17 44 30 = 11 19 24		12·28	17 36 20 = 11 11 15		11·92
July 13 - -	16 46 45 = 10 9 53		−5o 12·37	10 37 45 = 17 14 42		−5o 11·95
	16 59 0 = 22 6		12·37	10 55 35 = 17 32 55		11·93
	17 23 0 = 46 2		12·34	—	—	—

Digitized by Google

TABLE V.—CLOCK TIMES of *apparent* COINCIDENCE of BEATS of the CLOCKS at DURBAN and ADEN from MIRROR-SIGNALS exchanged between FINLAY at ADEN and MACLEAR at DURBAN by SUBMARINE CABLE.

Date.	Durban Sending.		ΔT_w.	Aden Sending.		ΔT_e.
	Durban Hut M.T. Clock.	Aden Sid. Clock.		Durban M.T. Clock.	Aden Sid. Clock.	
1881.	h m s	h m s	m s	h m s	h m s	m s
August 20 -	11 51 30 =	22 44 28	−55 50·25	12 9 42 =	23 2 40	−55 47·06
	11 57 50 =	22 50 49	50·14	12 13 41 =	23 6 40	47·36
				12 20 20 =	23 13 20	47·19
				12 24 59 =	23 18 0	47·38
				12 30 58 =	23 24 0	47·32
August 23 -	10 3 20 =	21 8 38	−55 49·88	10 17 32 =	21 22 50	−55 47·39
	10 9 0 =	21 14 19	49·89	10 24 1 =	21 29 20	47·26
	10 48 50 =	21 54 16	49·89	10 29 20 =	21 34 40	47·33
				10 35 19 =	21 40 40	47·28
				10 40 18 =	21 45 40	47·39
August 29 -	9 2 40 =	20 31 27	−55 49·83	9 24 2 =	20 52 50	−55 47·28
	9 9 0 =	20 37 48	49·78	9 30 1 =	20 58 50	47·29
	9 51 0 =	21 19 55	49·79	9 36 20 =	21 5 10	47·23
	9 56 50 =	21 25 46	49·82	9 42 9 =	21 11 0	47·26
	10 2 40 =	21 31 37	49·84			
September 2 -	12 11 10 =	23 56 26	−55 49·71	12 27 14 =	0 12 30	−55 47·08
	12 17 10 =	0 2 27	49·72	12 33 3 =	0 18 20	47·10
	12 53 50 =	0 39 13	49·62	12 39 32 =	0 24 50	47·01
	13 0 0 =	0 45 24	49·61	12 45 11 =	0 30 30	47·06
September 13 -	9 43 50 =	22 11 11	−55 49·85	9 59 39 =	22 27 0	−55 47·25
	9 50 10 =	22 17 32	49·81	10 5 48 =	22 33 10	47·24
	10 33 0 =	23 0 29	49·73	10 11 47 =	22 39 10	47·24
	10 38 20 =	23 5 50	49·85	10 17 26 =	22 44 50	47·31
				10 24 15 =	22 51 40	47·20
September 18 -	10 19 40 =	23 6 55	−55 49·75	10 36 25 =	23 23 40	−55 46·98
	10 26 10 =	23 13 26	49·67	10 42 34 =	23 29 50	46·97
	11 8 40 =	23 56 3	49·67	10 49 3 =	23 36 20	46·91
	11 14 40 =	0 2 4	49·68	10 55 12 =	23 42 30	46·89
				11 1 1 =	23 48 20	46·93
September 19 -	11 42 50 =	0 34 16	−55 49·89	11 58 34 =	0 50 0	−55 47·29
	11 49 10 =	0 40 37	49·84	12 4 33 =	0 56 0	47·32
	12 31 30 =	1 23 4	49·87	12 10 42 =	1 2 10	47·31
	12 38 0 =	1 29 35	49·79	12 16 41 =	1 8 10	47·32
				12 23 10 =	1 14 40	47·24
September 22 -	11 23 30 =	0 26 46	−55 49·80	11 33 15 =	0 36 30	−55 47·19
	12 6 10 =	1 9 33	49·76	11 39 34 =	0 42 50	47·15
	12 18 40 =	1 22 5	49·69	11 45 23 =	0 48 40	47·21
	12 48 40 =	1 52 10	49·75	11 51 32 =	0 54 50	47·18
				11 57 1 =	1 0 20	47·28
September 23 -	9 48 20 =	22 55 18	−55 49·89	10 10 41 =	23 17 40	−55 47·22
	9 54 40 =	23 1 39	49·85	10 16 10 =	23 23 10	47·31
	10 0 40 =	23 7 40	49·86	10 21 39 =	23 28 40	47·41
	10 43 10 =	23 50 17	49·85	10 27 58 =	23 35 0	47·36
	10 48 50 =	23 55 58	49·92	10 34 7 =	23 41 10	47·35
September 26 -	11 7 30 =	0 26 34	−55 49·79	11 23 26 =	0 42 30	−55 47·18
	11 13 40 =	0 32 45	49·79	11 29 15 =	0 48 20	47·22
	11 56 10 =	1 15 22	49·77	11 35 4 =	0 54 10	47·25
	12 1 50 =	1 21 3	49·84	11 41 3 =	1 0 10	47·27
				11 47 32 =	1 6 40	47·21
September 28 -	10 19 30 =	23 46 21	−55 49·75	10 29 30 =	23 56 20	−55 47·11
	10 26 0 =	23 52 52	49·69	10 35 39 =	0 2 30	47·10
	11 8 30 =	0 35 29	49·67	10 40 38 =	0 7 30	47·28
	11 15 0 =	0 42 0	49·60	10 46 27 =	0 13 20	47·32
				10 52 56 =	0 19 50	47·25
				10 59 5 =	0 26 0	47·23

Digitized by Google

The following signals were also exchanged between Maclear at Durban and Pett at the Cape upon nights when no Time Determinations were obtained at Durban, but on which signals were also exchanged between Durban and Aden.

These signals, therefore, serve to determine the Error of the Durban Clock on Cape time, and hence to give a direct determination of the difference of longitude between Aden and the Cape.

Times of Coincidence.

Date.	Cape Sending.			Durban Sending.		
	Cape Hut. Sid. Clock.	Durban Hut M. T. Clock.	Durban Clock Slow on C.M.T.	Cape Hut Sid. Clock.	Durban Hut M. T. Clock.	Durban Clock Slow on C.M.T.
1881.	h m s	h m s	$-\theta$	h m s	h m s	$+\theta$
August 26	19 15 40 =	9 45 19	−0 5o 3o·88	19 7 25 =	9 37 5	−0 5o 3o·52
	19 21 40 =	9 51 18	3o·85	19 31 34 =	10 1 10	3o·46
August 27	20 6 5 =	10 31 39	−0 5o 28·69	19 51 34 =	10 17 10	−0 5o 28·3o
	20 11 5o =	10 37 23	28·62	20 21 49 =	10 47 20	28·24
September 3	20 10 20 =	10 7 20	−0 5o 20·91	20 1 39 =	9 58 40	−0 5o 20·49
	20 16 35 =	10 13 34	20·93	20 26 13 =	10 23 10	20·51

The following are the mirror signals that were exchanged between Finlay at Aden and Maclear at Durban on the above nights.

Times of Coincidence.

Date.	Durban Sending.			Aden Sending.		
	Durban M. T. Clock.	Aden Sid. Clock.	$\Delta\lambda-\theta^1$.	Durban M. T. Clock.	Aden Sid. Clock.	$\Delta\lambda+\theta'$.
1881.	h m s	h m s	h m s	h m s	h m s	h m s
August 26	10 49 0 =	22 6 4	−1 46 1·91	10 59 57 =	22 17 0	−1 45 59·10
	10 55 10 =	12 15	1·89	11 5 16 =	23 20	59·22
	11 30 40 =	47 51	1·99	11 9 25 =	26 30	59·53
	11 37 0 =	54 12	1·94	11 16 34 =	33 40	59·53
				11 21 13 =	38 20	59·67
				11 27 52 =	45 0	59·46
*August 27	8 51 0 =	20 11 45	−1 46 1·87	9 13 14 =	20 34 0	−1 45 59·18
	8 57 10 =	17 56	1·85	9 20 3 =	40 50	59·05
	9 38 50 =	59 43	1·92	9 24 52 =	45 40	59·24
September 3	11 27 50 =	23 16 58	−1 46 2·17	11 49 51 =	23 39 0	−1 45 59·51
	11 33 50 =	23 22 59	2·17	11 55 50 =	45 0	59·50
	12 16 10 =	0 5 26	2·14	12 1 29 =	50 40	59·59
	12 22 0 =	0 11 17	2·17			

* Earth Currents very troublesome at Durban.

Digitized by Google

TABLE K.—SUMMARY of RESULTS of EXCHANGE of SIGNALS on LAND LINES for determining the DIFFERENCE of LONGITUDE of the CAPE and DURBAN.

	m	sec.		
I.—June 17	− 50	12·01	$-F' + \frac{P}{2} + \frac{I}{2} - \frac{F + F_s}{2} + \frac{M_r + M_s}{2}$.	
21		11·96	$-F' + \frac{P}{2} + \frac{I}{2}$	,, ,,
22		11·87	$-F' + \frac{P}{2} + \frac{I}{2}$	,, ,,
27		11·95	$-F' + \frac{P}{2} + \frac{I}{2}$	,, ,,

or the following values if the time determinations with the Hut Transit at the Cape are adopted :—

June 17	− 50	12·04	$-F' + M'$ - -	$-\frac{F_r + F_s}{2} + \frac{M_r + M_s}{2}$.
21		12·08	$-F' + M'$ - -	,, ,,
22		11·97	$-F' + M'$ - -	,, ,,
27		12·00	$-F' + M'$ - -	,, ,,
II.—Aug. 18	− 50	12·16	$-M' + \frac{P}{2} + \frac{I}{2}$ - -	$-\frac{M_r + M_s}{2} + \frac{P_r + P_s}{2}$.
19		12·08	,, ,, ,, - -	,, ,,
Sept. 19		12·13	,, ,, ,, - -	,, ,,
1881.				
III.—Dec. 23	− 50	11·91	$-M' + \frac{P}{2} + \frac{I}{2} + \frac{F_r + F_s}{2} - \frac{M_r + M_s}{2}$.	
1882.				
Jan. 8		12·32	$-M' + P$ - -	,, ,,
14		12·03	$-M' + P$ - -	,, ,,
20		12·16	$-M' + P$ - -	,, ,,
21		12·03	$-M' + \frac{P}{2} + \frac{I}{2}$	,, ,,
27		12·30	$-M' + P$ - -	,, ,,

or the following values if the time determinations with the Hut Transit at the Cape are adopted :—

1881.				
Dec. 23	− 50	12·19	$+F' - M'$ - - -	$+\frac{F_r + F_s}{2} - \frac{M_r + M_s}{2}$.
1882.				
Jan. 20		12·26	$+F' - M'$ - - -	,, ,,
27		12·29	$+F' - M'$ - - -	,, ,,
1882.				
IV.—July 10	− 50	12·14	$+(F' - P')$ - - -	$+\frac{F_r + F_s}{2}$ - - $-\frac{P_r + P_s}{2}$.
13		12·15	$+(F' - P')$ - - -	,, - - ,,

Digitized by Google

TABLE L.—RESULTS of EXCHANGE of MIRROR SIGNALS by SUBMARINE CABLE for determining the DIFFERENCE of LONGITUDE, DURBAN *minus* ADEN.

1881.	m. sec.				
Aug. 20 (1)	− 55 (48·73)	− F′	+ M′	$-\frac{F_m + F_s}{2}$	$+\frac{M_m + M_s}{2}$.
23	48·61	,,	,,	,,	,,
29	48·54	,,	,,	,,	,,
Sept. 2	48·36	,,	,,	,,	,,
13	48·53	,,	,,	,,	,,
18	48·32	,,	,,	,,	,,
19	48·57	,,	,,	,,	,,
22	48·48	,,	,,	,,	,,
23	48·60	,,	,,	,,	,,
26	48·51	,,	,,	,,	,,
28	48·45	,,	,,	,,	,,

TABLE M.—RESULTS of EXCHANGES of SIGNALS on the CABLE and LAND LINE (on nights when no time determinations were secured at Durban) for determining the DIFFERENCE of LONGITUDE, CAPE *minus* ADEN.

1881.	h	m	sec.					
Aug. 26	− 1	46	0·68	$-(F' + \Delta F_n')$	$+\frac{P}{2}$	$+\frac{I}{2}$	$-\frac{F_m + F_s}{2}$	$+\frac{M_m - M_r}{2}$ $+\frac{P_r + P_s}{2}$.
27			0·52	$-(F' + \Delta F_n')$	$+\frac{P}{2}$	$+\frac{I}{2}$	$-\frac{F_m + F_s}{2}$	$+\frac{M_m - M_r}{2}$ $+\frac{P_r + P_s}{2}$.
Sept. 13			0·85	$-(F' + \Delta F_n')$	P		$-\frac{F + F_s}{2}$	$+\frac{M_m - M_r}{2}$ $+\frac{P_r + P_s}{2}$.

(1) The observations of August 20 must be rejected on account of the unsatisfactory nature of the signals received at Aden. The motion of the spot of light was so small and uncertain, that after attempting to estimate two coincidences, Mr. Finlay was unable to observe any more. A fault was afterwards discovered and corrected in the Hut-connections with the Telegraph Office, when the signals after August 22 became quite sharp and satisfactory. A glance at column ΔT_w of Table V. p. [40] is sufficient to prove the sluggishness of the signals in question, for the value of ΔT_w is nearly $0^{sec}\cdot4$ above the mean, whilst the value of ΔT_e (the signals observed at Aden) is near the mean of other nights.

Digitized by Google

CHAPTER VII.

RESULTS OF OBSERVATIONS FOR PERSONAL EQUATION.

From Table A., Chapter IV., with the rates of the Transit Clock R_d as determined in Chapter V., we obtain directly the following results for the relative personal equation of Pett and Freeman :—

I.		II.		III.	
1881.	P−I. sec.	1881.	sec.	1881.	sec.
April 9 -	+·267	Aug. 18 -	+·190	Dec. 23 -	+·376
April 14 -	·221	Aug. 19 -	·184	Dec. 29 -	·331 ½ weight.
May 12 -	·300	Aug. 25 -	·244	1882.	
May 23 -	·245	Aug. 26 -	·160	Jan. 9 -	·182 ½ weight.
June 16 -	·218	Aug. 27 -	·200	Jan. 21 -	·188
June 17 -	·202	Aug. 28 -	·211	Feb. 13 -	·176
June 20 -	·162	Sept. 19 -	·272	Feb. 14 -	·216
June 21 -	·170			Feb. 15 -	·131
June 22 -	·153			Feb. 17 -	·241
June 27 -	·218				

Whence from—

	P−I. sec.	No. of Obs.	Mean Error. sec.
Group I. -	+0·216	10	±0·015
Group II. -	·209	7	± ·015
Group III. -	·226	7	± ·022
Mean -	+0·217 sec.	24	±0·010

and the probable error of one comparison = ±0·035.

We found, from the discussion in Chapter V., that the probable error of a time determination by Pett or Freeman is ± 0ˢ·021, and each of the above determinations of full weight depends on two such determinations by each observer. If, therefore, the personal error remained quite constant, the probable error of each of the above results should be ± 0ˢ·021, but we find it = ±0ˢ·035, which shows that this relative personal equation has a probability of changing ±0ˢ·028 from night to night, although it appears to be very constant in the long run. This latter is confirmed by the fact that in 1879 their relative personal equation for stars of like Declination was found from determinations on eight nights to be—

$$P - I = + 0^s\cdot204.$$

It is, therefore, reasonable to assume that these observers may be accepted as a reliable standard, and their personal equations may be conveniently adopted as follows :—

$$\frac{P + I}{2} = \pm 0\cdot000 \text{ sec.}$$

$$P = + \cdot109.$$

$$I = - \cdot109.$$

Digitized by Google

The substitution of these values in Table G. in conjunction with the results of Table B. leads to the following values of F′ and M′ :—

1881.	F′. sec.
April 9	+0·32
April 14	+ ·27
May 12	+ ·21
May 23	+ ·16
Mean	+0·24 ±·035

1881.	M′. sec.
April 9	+0·18
April 13	+ ·10
April 14	+ ·11
May 12	+ ·07
May 20	+ ·17
May 23	+ ·07
	+0·12 ±·020

1881.	sec.
Dec. 23	+0·28
Dec. 30	+ ·09
1882.	
Jan. 17	+ ·12
Jan. 20	+ ·21
Jan. 26	+ ·20
Jan. 27	+ ·10
Mean	+0·17 ±·030

1881.	sec.
June 16	+0·07
June 17	+ ·03
June 20	− ·05
June 21	+ ·12
June 22	+ ·10
June 27	+ ·06
Mean	+0·06 ±·024

1882.	sec.
Feb. 13	+0·16
Feb. 14	+ ·12
Feb. 15	+ ·30
Feb. 17	+ ·19
Mean	+ 0·19 ±·038

1882.	sec.
Feb. 13	+0·12
Feb. 14	+ ·21
Feb. 15	+ ·21
Feb. 17	+ ·09
Mean	+0·16 ±·030

We have also, from the observations at Durban, Table C., the following values of the difference of personal equation of Finlay and Maclear :—

1881.	F′ − M′. sec.
November 20	+ 0·23
November 21	+ ·30
November 26, November 27 (1)	+ ·16 weight 2
	+ 0·21 ±·033

(1) *See* footnote in Table C. p. [20].

Digitized by Google

It does not appear that the personal equation of the observers follows any law depending on the time, nor do the separate mean values of F′ and M′ appear to differ much more than one would expect from the *mean errors* attached to each result. But the independent result for F′ — M′ obtained at Durban differs by about three times its mean error from that which is derived for F′ — M′ by comparisons at the Cape. It is, therefore, not improbable that the personal equations of Finlay and Maclear are *really* different at this time, and it will be desirable to discuss the results, *first* assuming that the personal equation of Finlay and Maclear is really constant, and *second*, that there was a real change in Finlay and Maclear's personal equation about the time in question.

On the first assumption we have the following equations to satisfy:—

			sec.	p	v
From Obs.	1881 April and May	F′	= +0·24	4	+·022
	1881 April and May	M′	= + ·12	6	+·032
	1881 June	M′	= + ·06	6	−·028
	1881 November at Durban	F′ − M′	= + ·21	4	+·080
	1881 December, 1882 Jan.	F′	= + ·17	6	−·048
	1882 February	F′	= + ·19	4	−·028
	1882 February	M′	= + ·16	4	+·072

These, having regard to weight, lead to the normal equations—

		sec.
18·00 F′	− 4·00 M′	= + 3·58
− 4·00	+ 20·00	= + 0·88

and their solution, and the substitution of the resulting values of F′ and M′, to the following values of their probable errors:—

F′ = + 0·218 sec. with the probable error ± 0·020 sec.
M′ = + ·088 with the probable error ± ·019

and the probable error of a comparison of weight *unity* = ± 0ˢ·084.

The consideration of the *second* assumption will be best deferred till the final discussion of the longitude.

These determinations of Personal Equation are only applicable to the results of the various observers so long as the conditions of observation remain the same.

In course of the observations for Personal Equation made at the Cape in 1879 for Stars of different Declination, it was found that there was a marked change in the relative Personal Equation of the observers at the Zenith.

Observations were made by two observers at a time in various combinations, so that each observer compared successively directly with each of the other four observers. The observations were made in zones of 15° in Declination, and the Personal Equations for each zone were deduced from a combination of the results of each zone on the assumption that the sum of the Personal Equations for that zone is Zero. One observer noted the Clock Time of Transit over the first three wires, the other over the three last wires; for the next Star the order was reversed.

Digitized by Google

The results were the following:—

Observer.	N.P.D. 90°—105°.	N.P.D. 105°—120°.	N.P.D. 120°—135°. (1)	N.P.D. 135°—150°.	N.P.D. 150°—165°.	N.P.D. 165°—175°.
	s s	s s	s s	s s	s s	s s
G	−·061 ±·005	−·078 ±·005	−·015 ±·004	+·035 ±·004	+·120	+·350
F	−·048 ±·005	−·066 ±·005	−·081 ±·003	−·122 ±·004	−·115 ±·035	−·170 ±·057
M	+·113 ±·005	+·104 ±·005	+·067 ±·005	+·117 ±·004	+·134 ±·034	+·227 ±·036
P	−·091 ±·005	−·095 ±·005	−·082 ±·003	−·140 ±·004	−·182 ±·031	−·217 ±·041
I	+·087 ±·005	+·134 ±·005	+·110 ±·005	+·109 ±·004	+·043 ±·037	−·189 ±·056

(1) Observations made "face North" are here rejected.

Remembering the results of a Paper by Captain Campbell, R.E., "On a peculiarity of Personal Equation" (*Monthly Notices*, R.A.S., Vol. XXXVII., pp. 283, 284), I instituted a series of experiments to ascertain whether this sudden change of "Personal Equation" might depend (as was the case with Captains Campbell and Heaviside) on whether the Star crossed the field of the telescope from (observer's) right to left or left to right,—that is, whether he observed a Star to South or North of the Zenith.

Accordingly a series of observations was arranged in which each observer noted the Transit of a Zenith Star over three or four wires with his feet towards the South, and then the remaining wires with his feet towards the North, or *vice versâ*, taking care to alternate the arrangement of the observations so as to eliminate the effect of errors in the adopted wire intervals. The observations in the two conditions were then separately reduced to the middle wire. When a number of stars had been thus observed by each observer on each of four nights it was found that, in the mean for every observer, the Clock Times of Transit across the middle wire were greater when the observer faced South than when he faced North. In other words, if these Stars had been used to determine the Error of the Clock, the deduced amount of "Clock Slow" would have been numerically smaller for Stars South than for Stars North of the Zenith.

The following Table exhibits the corrections to be applied to the values of Δt to Stars near the Zenith when the observer faces South, to reduce them to values of Δt when the observer faces North.

	s	s	No. of Stars.
F =	+·063	±·017	21
	+·079	±·011	32
	+·111	±·025	16
	+·078	±·012	28
P =	+·056	±·020	18
	+·009	±·019	16
	−·023	±·021	22
	+·016	±·018	24

	s	s	No. of Stars.
M =	+·145	±·025	23
	+·117	±·017	23
	+·112	±·023	20
	+·115	±·019	24
I =	+·014	±·030	24
	+·076	±·018	11
	+·144	±·027	23
	+·029	±·022	17

The mean results are—

	s
F =	+·079
M =	+·122
P =	+·015
I =	+·066

Digitized by Google

It is somewhat remarkable that all these results have the same sign :—For myself I found the same, the mean on two nights being + 0^{s}·076.

It is, perhaps, worthy of note that Mr. Pett, whose personal equation is least changed by the apparent direction of the Star's motion, is ambidextrous; he uses his right hand in writing, but employs his left hand in the use of tools.

For Maclear, Pett, and Freeman I simply quote the above results here on account of their general interest, and for their observations there is no necessity to consider the effect of such personality on the Longitude, since all the Time Stars which they observed at the Cape and Durban were situated to the North of the Zenith.

Finlay, on the other hand, observed the same list of Time Stars at Aden as he did at the Cape and Durban; but at Aden these Stars culminate to the South of the Zenith, and therefore move across the field of view of his Transit apparently from right to left instead of from left to right.

According to the experiments just quoted, Finlay's Personal Equation at Aden would require the correction +0^{s}·079 to reduce to his habit of observing the same Stars at the Cape or Durban. But as his habit of observation might have changed between 1879 and 1881 it was desirable to repeat the experiments before and after the expedition.

By placing a reversing prism between the eyepiece and the observer's eye it is possible to make any Star appear to move from right to left or from left to right at pleasure, by rotating the prism 90°. In this way the correction of Finlay's Personal Equation for Stars crossing the field of view from right to left (*i.e.*, for Stars South of the Zenith as seen in a reversing telescope) to reduce to his habit of observing Stars crossing from left to right (*i.e.*, for Stars North of the Zenith) was found to be—

	sec.	sec.
From 31 transits before the expedition	+ 0·060	± 0·012.
„ 21 „ after „	+ ·080	± ·010.

For Finlay's observations at Aden the correction to the observed Clock Error to reduce to his habit of observation in the Southern Stations is—

$$\Delta F_n' + 0^{sec}\cdot07 \pm 0^{sec}\cdot008.$$

The following are the available materials for determining the Personal Equation of Mr. Pett when observing with a portable Transit (P′).

Previous to his departure for Natal observations were made at the Cape in which the error of the Hut Clock was independently determined by symmetrically arranged observations made both by Mr. Finlay and Mr. Pett with the same instrument, and so that the clock rate as well as the errors of the Star places are practically eliminated from the results of the observations on two nights. Mr. Pett was delayed for some time in Natal in connexion with the erection of the Natal Observatory and Equatorial, and the observations of *Victoria* and *Sappho*. He had thus no opportunity of meeting Mr. Finlay till he joined him at the Transit of Venus Station at Aberdeen Road in November, where the Durban Transit and Hut were erected, and signals exchanged for determining the longitude of the station. On Nov. 29 and 30 Mr. Finlay observed whilst Mr. Pett sent and received the signals, whilst on Nov. 28 and Dec. 1 the signals were sent by Mr. Pett, whilst Mr. Finlay observed.

Digitized by Google

On the return of both observers to the Cape they again compared Personal Equation on two nights. The results of the comparisons at the Cape are the following :—

BEFORE MR. PETT'S DEPARTURE FOR DURBAN.(1)

1882.	Hut Clock slow.					
	h	m	m	sec.	F′ − P′ sec.	Mean.
May 22, at	12	45	− 1	7·098 + F′	− ·090	± 0·000.
	12	44		7·188 + P′		
May 27	12	42	− 0	14·364 + F′	+ ·090	
	12	31		14·274 + P′		

AFTER MR. PETT'S RETURN FROM DURBAN. (1)

1883.						
Jan. 20	5	25	− 1	2·663 + F′	+ ·040	+ 0·032.
	5	26	− 1	2·623 + P′		
Jan. 22	5	26	− 1	6·958 + F′	+ ·023	
				·935 + P′		

Whence $F' - P' = + 0{\cdot}016$ sec., with a mean error $= \pm 0{\cdot}038$ sec.

From the time determinations and exchange of signals at Aberdeen Road, the resulting longitudes were—

Aberdeen Road, west of Cape.(2)

1882.	h	m	sec.	
Nov. 29 and 30,	− 0	23	20·807	+ M′ − F′ − P_r − P_s.
28 and Dec. 1,			20·843	+ M′ − P′ − F_r − F_s.

Whence $F' - P' + P_r + P_s - (F_r + F_s) = + 0{\cdot}036$ sec.,
and substituting the values of P_r, P_s, F_r, F_s, given in the conclusion of the present chapter we obtain—

$$F' - P' = + 0{\cdot}031 \text{ sec.}$$

Giving equal weight to each of these values, we obtain as definitive—

	Mean Error.
sec.	sec.
$F' - P' = + 0{\cdot}021$	$\pm 0{\cdot}031$.

(1) The details of these observations are given for Mr. Finlay at pp. 42 and 43, and for Mr. Pett at p. 53.

(2) The details of this operation will be afterwards published in connexion with other longitude determinations in South Africa.

Digitized by Google

Personal Equation in Sending and Observing Signals.

To determine the relative personal error of the observers in sending and receiving signals, the Cape Normal Mean Time Clock was compared with the Cape Hut Sidereal Clock by means of telegraphic signals over a short line precisely as in the longitude operations connecting distant places, described pp. [14], [15], excepting that whilst one observer sent signals from one clock only, the signals were received and coincidence recorded by two observers at the other clock. The observers were so interchanged, and the times of their respective observations so symmetrically arranged that the required Personal Equations were obtained independent of clock rate. For example, 1882, Feb. 17 :—

Finlay, sending from M. T. Clock.

Maclear recording.							Pett recording.						
Sid. Clock.				M. T. Clock.			Sid. Clock.				M. T. Clock.		
h	m	s		h	m	s	h	m	s		h	m	s
20	16	43	=	22	22	40	20	16	43	=	22	22	40
	48	28	=		54	20		48	18	=		54	10

Maclear, sending from M. T. Clock.

Finlay recording.							Pett recording.						
20	23	14	=	22	29	10	20	23	4	=	22	29	0
	42	7	=		48	0		41	52	=		47	45

Pett, sending from M. T. Clock.

Finlay recording.							Maclear recording.						
20	29	30	=	22	35	25	20	29	25	=	22	35	20
	35	41	=		41	35		35	46	=		41	40

Finlay, sending from Sidereal Clock.

Maclear recording.													
h	m	s		h	m	s		h	m	s		h	m	s
20	55	0	=	23	0	51		20	54	50	=	23	0	41
21	25	20	=		31	6		21	25	15	=		31	1

Digitized by Google

MACLEAR, sending from Sidereal Clock.

21	1	0	=	23	6	50		21	1	5	=	23	6	55
	19	15	=		25	2			19	20	=		25	7

PETT, sending from Sidereal Clock.

21	7	15	=	23	13	4		21	7	15	=	23	13	4
	13	20	=		19	8			13	15	=		19	3

Assuming the M. T. Clock free from error, and that the mean of the Personal Equations is Zero, we obtain the following corrections to the Sidereal Clock, and from the difference of the separate results from the mean we obtain the desired equations which express the personal error in sending and receiving signals according to the notation on p. [16]:—

By Signals from the M. T. Clock.

Sid. Clock Correction =	m	s	Resulting Equations.	s
	− 0	7·84	$F_s + M_r =$	− 0·005
		·86	$F_s + P_r =$	+ ·015
		·83	$M_s + F_r =$	− ·015
		·86	$M_s + P_r =$	+ ·015
		·84	$P_s + F_r =$	− ·005
		·84	$P_s + M_r =$	− ·005

Then by subtraction we obtain—

	s		s
$F_s - M_s =$	0·00	$F_r - M_r =$	0·00
$F_s - P_s =$	·00	$F_r - P_r =$	− ·03
$M_s - P_s =$	− ·01	$M_r - P_r =$	− ·02

Similarly by signals from the Sidereal Clock we obtain—

$F_s - M_s =$	+ 0·03	$F_r - M_r =$	0·00
$F_s - P_s =$	+ ·01	$F_r - P_r =$	+ ·01
$M_s - P_s =$	− ·02	$M_r - P_r =$	− ·02

It is unnecessary to give similar details of all the observations; the results are summarised in the following tables:—

Digitized by Google

COMPARISONS made before the LONGITUDE OPERATIONS.

M. T. Clock sending.

1881.	$F_s - M_s$	$F_s - P_s$	$M_s - P_s$	$F_r - M_r$	$F_r - P_r$	$M_r - P_r$
	s	s	s	s	s	s
March 11	+ ·02	+ ·04	·00	+ ·01	− ·01	·00
16	·00	− ·02	+ ·01	− ·03	+ ·02	·00
24	·00	+ ·02	+ ·02	·00	− ·01	− ·01
25	·01	+ ·02	+ ·02	− ·01	− ·01	·00
May 19	·00	− ·03	+ ·01	·00	+ ·01	− ·01

COMPARISONS made after the LONGITUDE OPERATIONS.

M. T. Clock sending.

1882.	$F_s - M_s$	$F_s - P_s$	$M_s - P_s$	$F_r - M_r$	$F_r - P_r$	$M_r - P_r$
Feb. 17	·00	·00	− ·01	·00	− ·03	− ·02
18	− ·03	− ·03	− ·03	− ·01	− ·06	− ·02
19	+ ·04	+ ·02	+ ·01	− ·01	·00	− ·02
20	− ·01	− ·03	+ ·01	− ·03	·00	·00

Sid. Clock sending.

Feb. 17	+ ·03	+ ·01	− ·02	·00	+ ·01	− ·02
18	·00	+ ·01	+ ·02	− ·02	+ ·01	·00
19	+ ·04	+ ·01	+ ·01	− ·02	·00	− ·02
20	·00	+ ·03	+ ·02	·00	·00	+ ·01

and we have in the mean—

Before the operations	+ ·006	+ ·006	+ ·010	− ·006	·000	− ·004
After the operations	+ ·009	+ ·002	+ ·002	− ·012	− ·009	− ·012

Taking the means and putting the sum of the unknowns = Zero, we have—

$$F_s - M_s = +\overset{s}{\cdot}0075 \qquad F_r - M_r = -\overset{s}{\cdot}009$$
$$F_s - P_s = +\cdot004 \qquad F_r - P_r = -\cdot0045$$
$$M_s - P_s = +\cdot006 \qquad M_r - P_r = -\cdot008$$
$$F_s + M_s + P_s = \cdot000 \qquad F_r + M_r + P_r = \cdot000$$

and the solution of the equations gives—

$$F_s = +\overset{s}{\cdot}0054 \qquad F_r = -\overset{s}{\cdot}0066$$
$$M_s = -\cdot0021 \qquad M_r = +\cdot0024$$
$$P_s = -\cdot0013 \qquad F_r = +\cdot0042$$

For comparing the Personal Equations of Mr. Finlay and Mr. Maclear in observing signals through submarine lines by means of minor galvanometers, I arranged the following plan, which was well carried out. I instructed Mr. Finlay to leave his clock at Aden, and to train a member of the telegraph staff there in the art of sending time signals. The duty was cordially undertaken by Mr. A. W. Prosser, of the telegraph staff there, and he acquired great skill in sending signals with uniformity and precision. Mr. Finlay brought with him the Thomson dead-beat galvanometer, which he had used at Aden, and

Digitized by Google

mounted it in the hut at Durban, where the galvanometer used by Mr. Maclear was also mounted. Both galvanometers were then put in the Aden circuit, and signals sent by Mr. Prosser at Aden were observed simultaneously by Mr. Finlay and Mr. Maclear at Durban, *each observer using his own galvanometer, but recording the same signal at the same place by the beats of the same clock.*

Any difference in the recorded times for coincidence between the first movement of the spot of light and the beat of the clock was therefore due either to Personal Equation or to a different degree of sensibility in the two galvanometers. For longitude purposes it is obviously unnecessary to separate the observer's personality from the difference of the instruments, and therefore no observations were made with an exchange of galvanometers.

The following are the results of the experiments in question, taking Finlay as standard, that is, putting $F_m = 0$.

FINLAY'S galvanometer first on line.

1881	Number of observed coincidence.	Deduced value of M_m.
		s
Nov. 19	6	− 0·305
20	8	·342
21	11	·273
29	9	·178
Dec. 2	7	·292
3	6	·220

MACLEAR'S galvanometer first on line.

1881	Number of observed coincidence.	Deduced value of M_m.
		s
Nov. 20	13	− 0·306
21	5	·186
29	11	·221
Dec. 2	9	·254
3	9	·261

Giving equal weight to the observations of each day, we obtain—

	M_m.	Mean Error.
From observations with Finlay's galvanometer first	−·268	± ·024.
„ „ „ Maclear's „ „	−·246	± ·021.

And from the mean of these results,

$$M_m = -0^{s}\cdot257 \text{ with a mean error of } \pm 0^{s}\cdot016.$$

Digitized by Google

Collecting finally the mean values of the various determinations of Personal Equation contained in the present chapter, we have—

In time determination.

	s	Mean error.
$F' =$	$+ 0{\cdot}218$	$\pm {\cdot}020$
$M' =$	$+ {\cdot}088$	$\pm {\cdot}019$
$P =$	$+ {\cdot}109$	$\pm {\cdot}010$
$I =$	$- {\cdot}109$	$\pm {\cdot}010$
$(F' - P') =$	$+ {\cdot}021$	$\pm {\cdot}031$
Correction to F' in N. Hem. $\Delta F_n'$	$+ {\cdot}070$	$\pm {\cdot}008$

In sending and receiving signals.

	s	Mean error.
$F_s =$	$+ 0{\cdot}005$	The *mean errors* of these quantities are practically insensible.
$M_s =$	$- {\cdot}002$	
$P_s =$	$- {\cdot}001$	
$F_r =$	$- {\cdot}007$	
$M_r =$	$+ {\cdot}002$	
$P_r =$	$+ {\cdot}004$	
$F_m =$	${\cdot}000$	
$M_m =$	$- {\cdot}257$	$\pm {\cdot}016$.

Digitized by Google

CHAPTER VIII.

FINAL RESULTS OF THE LONGITUDE OPERATIONS.

Cape—Durban.

The definitive result for the difference between the longitudes of the Cape and Durban, from the preceding observations, depends upon three independent operations, viz. :—

1. Finlay at Durban.
2. Maclear at Durban.
3. Pett at Durban.

A discussion of the results in this form furnishes a very severe test of the accuracy of the determination of the Personal Equation of the observers and of the reliability of the final result.

So arranged, these results are the following, obtained by substituting the numerical values of the symbolical representations of the various Personal Equations in the results for the difference of longitude Cape—Durban given in Table K., p. [42].

1. Finlay at Durban.

Date.	Observers at the Cape.		Mean.	Weight.
	M'.	$\frac{P}{2} + \frac{I}{2}$.		
	m s	s	h m s	
1881, Jan. 17	− 50 12·169	12·227	− 0 50 12·198	1·5
„ 21	·209	·177	·193	1·5
„ 22	·099	·087	·093	1·5
„ 27	·129	·167	·148	1·5

2. Maclear at Durban.

Date.	Observers at the Cape.			Mean.	Weight.
	F'.	$\frac{P}{2} + \frac{I}{2}$.	P.		
	m	s		m s	
1881, Aug. 18	− 50	12·246		− 50 12·246	1·0
„ 19		·166		·166	1·0
Sept. 19		·216		·216	1·0
Dec. 23	12·061	·004		·033	1·5
1882, Jan. 8			12·300	·300	1·0
„ 14			·010	·010	1·0
„ 20	·131		·140	·136	1·5
„ 21		·119		·119	1·0
„ 27	·161		·280	·221	1·5

Digitized by Google

3. PETT at DURBAN.

	Finlay (F′) at the Cape.	
		h m s
1882, July 10		− 0 50 12·122
	13	·132

The accidental mean errors of the means of these results, may be computed from the agreement of the separate determinations in operations 1 and 2, and are respectively ± 0ˢ·024 and ± 0ˢ·035, having regard to the weights. For Operation 3 I have assumed the accidental mean error to be ± 0ˢ·056 (1), as it cannot be satisfactorily derived from only two determinations.

The results are also affected by the errors in determining the Personal Equations, and these enter, as follows, into the mean results :—

1. - - - $\sqrt{(F'\epsilon)^2 + (0{\cdot}5\ M'\epsilon)^2 + (0{\cdot}25\ P\epsilon)^2 + (0{\cdot}25\ I\epsilon)^2} = \pm$ 0ˢ·022.

2. - - - $\sqrt{(0{\cdot}17\ F'\epsilon)^2 + (M'\epsilon)^2 + (0{\cdot}58\ P\epsilon)^2 + (0{\cdot}25\ I\epsilon)^2} = \pm$ ·021.

3. - - - $(F' - P')\epsilon = \pm$ ·031.

Where F′ϵ, M′ϵ, &c. denote the *mean errors* of the determinations of F′, M′, &c.

Collecting these results, we have—

DURBAN, EAST OF THE CAPE.

	Observer at Durban.	Resulting Longitude.	Mean Errors.		Resulting Mean Error.	Relative Weight.
			Accidental.	Per Eqⁿ.		
		h m s	s	s	s	
1	Finlay -	0 50 12·158	±0·024	±0·22	±0·033	2·30
2	Maclear -	·156	± ·035	·021	·041	1·49
3	Pett -	·126	± ·056	·031	·064	0·61

Where the relative weights have been computed according to the *mean errors*, weight 1 corresponding with a mean error = ± 0ˢ·050.

These independent results thus accord much within the limits of their *mean errors*, and afford good ground for accepting the mean result, having regard to weight, viz. :—

Durban, East of the Cape. h m s 0 50 12·153

With a *mean error* = ±·024(2)

as entirely satisfactory, and as affording strong proof of the general constancy of the Personal Equation of the observers, and of the accuracy of its determination in each case.

(1) In Chapter VII., the value of the personal equation F′ − P′ is determined with a *mean error* of ± 0ˢ·038 from observations on four nights; the corresponding mean error for two nights is ± 0ˢ·056.

(2) This *mean error* slightly in excess of the true *mean* error of the result, as the symbolical expressions F′ and M′ have opposite signs in operations 1 and 2, and thus the errors of their determination are partially eliminated from the mean result. It seems better, however, to regard the operations as strictly independent.

Digitized by Google

Longitude Durban—Aden.

The arithmetical mean of the 10 results of Table L., p. 43, gives for the difference of Longitude Durban—Aden, apart from personal equation—

$$-\ 55^{m}\ 48{\cdot}497^{s}\ \textit{mean error}\ \pm\ 0{\cdot}029^{s}.$$

The determinations on the different dates, however, rest on observations of unequal weight.

On Aug. 29 and Sept. 23 there are complete time determinations both before and after the exchange of signals. To these nights I have given Weight 2.

On Aug. 23, Sept. 18, 19, 22, 28, complete time determinations were obtained before and after signals at only one of the stations, with one complete time determination before or after signals at the other. To these nights I have given Weight 1·5.

On the remaining nights there is one complete time determination, either before or after signals, at each station. To these nights I have given Weight 1.

Having regard to these weights, the resulting mean is—

$$-\ 0^{h}\ 55^{m}\ 48{\cdot}505^{s}\ \textit{mean error}\ \pm\ 0{\cdot}029^{s}.$$

This result is affected by personal error corresponding to the expression—

$$-\ (F' + \Delta F'_n) + M' - \frac{F_m + F_s}{2} + \frac{M_m + M_s}{2}.$$

If we assume the personal equation of the observers to have remained constant throughout, we have only to substitute the values of these symbolical expressions, as determined in last chapter, when the correction to be applied to the Longitude becomes—

$$-\ 0{\cdot}332^{s} \pm 0{\cdot}030^{s}.$$

And the value of the Longitude Durban—Aden is

$$-\ 0^{h}\ 55^{m}\ 48{\cdot}837^{s}\ \textit{mean error}\ \pm\ 0{\cdot}042^{s}.$$

Besides this result we have exchanges of signals, Aden—Durban and Durban—Cape, on three nights, upon all of which complete time determinations, both before and after the signals, were obtained at both the extreme stations, although the sky was clouded at Durban.

The results are—

Longitude Cape—Aden.

1881. h m s

Aug. 26 $-\ 1\ 46\ 0{\cdot}68 - (F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2} - \frac{F_m + F_s}{2} + \frac{M_m - M_r}{2} + \frac{P_r + P_s}{2}.$

27 $\quad 0{\cdot}52 - (F' + \Delta F_n') + \frac{P}{2} + \frac{I}{2}$ „ „ „

Sept. 3 $\quad 0{\cdot}85 - (F' + \Delta F_n') + P$ „ „ „

Substituting the values of the symbolical expressions, we have—

1881.

Aug. 26 $-\ 1\ 46\ 1{\cdot}098$

27 $\quad 0{\cdot}938$

Sept. 3 $\quad 1{\cdot}160$

Mean $-\ 1\ 46\ 1{\cdot}065$ with an accidental *mean error* $= \pm\ 0{\cdot}067^{s}$.

Digitized by Google

The *mean error* of the determination of the Personal Equations is $\pm$ 0^s·024, so that the real *mean error* of this result is—

$\pm$ 0^s·070.

The difference of Longitude Cape—Aden is thus determined by two independent operations, viz. :—

		h	m	s	Mean Error. s	
	Cape—Durban	− 0	50	12·153	± 0·024	p. [56].
	Durban—Aden	− 0	55	48·837	± ·042	p. [57].
Hence -	Cape—Aden	− 1	46	0·990	± ·048	
	and, directly	− 1	46	1·065	± ·070	p. [57].

Whence we have definitively—

h m s

Aden, East of Cape Transit Circle, 1 46 1·015

With a *probable error* = ± ·027

Greenwich—Aden.

The longitude of Aden, as already explained in the Introduction, has been determined by two independent series of operations.

Series A.

Greenwich—Mokattam (near Cairo).

	h	m	s	Mean Error. s	
Apparent difference of longitude	− 2	5	6·58	± 0·028	(1)
Personal Equation in giving and receiving signals			+ ·09	± ·050	(2)
Personal Equation in observing transits			+ ·25	± ·079	(3)
	− 2	5	6·24	± ·098	

Notes.

(1.) Transit of Venus, 1874. British Observations, p. 283; *mean error* is deduced from agreement of results on the four different nights.

(2.) No satisfactory particulars are published about the determination of the various Personal Equations in giving and receiving signals; it is evident from the remarks (*loc. cit.*, p. 287) that the *mean error* of the combined equations is certainly not over estimated at ± 0·35.

(3.) Loc. cit., p. 288; *mean error* deduced from agreement of results on seven nights.

Mokattam—Suez.

	h	m	s		
Apparent difference of longitude	− 0	5	6·881	± 0·066	(4)
Correction for aberration and Personal Equation			−·050	± ·080	(5)
	− 0	5	6·931	± 0·132	

Digitized by Google

Notes.

(4.) Transit of Venus, 1874. British observations, p. 345; mean error determined from agreement of the four results.

(5.) The determination of the equation, B − H (loc. cit., p. 329) is affected with a mean error = ± 0s·063 in star observing, exclusive of the error in the determination of their personal error in giving and receiving signals.

Suez—Aden.

	h m s	s	
Definitive difference of longitude	− 0 49 42·662		(6)
Mean error (accidental)		± 0·033	(6)
Mean error in determination of Personal Equation		± ·050	(7)
	− 0 49 42·662	± 0·060	

Notes.

(6.) Determined by Captains Campbell and Heaviside, R.E., on May, 25, 26, 27, 28, 29, 30, 1877. (G.T. Survey of India, Vol. IX., p. (105)) The accidental mean error of the result is deduced from the agreement of the results on the six nights of observation.

(7.) The Personal Equation employed depends on the following determination of the equation H − C, made at Bombay, *loc. cit.*, Table X., p. 56.

	No. of Stars.	Stars North of Zenith.	Apparent Mean Error.	Stars South of Zenith.	Apparent Mean Error.
		s	s	s	s
1877, April 4	4	+ ·085	± ·023	− ·028	± ·014
5	3	+ ·023	± ·007	− ·004	± ·005
7	7	+ ·052	± ·008	− ·025	± ·011
5	5	− ·027	± ·014	− ·042	± ·004
		+ ·033		− ·025	
Mean Error	-	- ± ·024		± ·008	

Unfortunately these observations were all taken previous to the expedition, and collateral evidence appears to show that about the time in question the relative Personal Equation of the observers was not quite constant.

	H − C N.	H − C S.
At Bolarum, 4 nights in December 1875	+ ·111	+ ·045*
At Madras, Bombay, and Bangalore } February—April 1876, 5 nights	+ ·123	+ ·038
At Bangalore, 3 nights in December 1876	+ ·133	+ ·066

All these results are in very satisfactory accord, with a very slight tendency to increase with the time; but between 1876 December, and April 1877 we find, as above, a sudden change of nearly 0s·1 diminishing, and it is thus difficult to suppose that with the additional disturbance of a sea voyage the Personal Equation of the observers remained constant from the beginning of April till the end of May. I think, therefore, that the mean error of the Personal Equation cannot be over estimated at ± 0s·050.

* In these means the results of each night have equal weight, instead of a weight deduced from the so called *mean error* of each night; such as is done in the G.T. Survey of India. This latter plan ignores the well known fact that the personal error of every observer varies from night to night by a quantity which is large compared with the accidental error of observation. For example, the accidental mean error of a night's work in the above quoted determinations, computed from the observations of the same night, as compared with the actual errors deduced from the agreement of the results on different nights is—

	N. Stars.	S. Stars.
Computed	± ·014	± ·010
Actual	± ·048	± ·016

Digitized by Google

Series B.

This series depends on observations made by Dr. Löw, chief of the German expedition for observation of the Transit of Venus at Mauritius in 1874, and by myself in connexion with the expedition of Lord Lindsay (now Earl of Crawford and Balcarres) to the same island for the same object.

The observations have been independently reduced on part of both expeditions. One of these discussions is published by Lord Crawford in full detail (Dunecht Publications, Vol. III.) under the final supervision of Dr. Copeland. The results of an independent discussion by Dr. Auwers have been kindly communicated to me by the author in a letter dated 1884, June 20.

Dr. Copeland's results are as follows:—

	h m s	Dunecht Pubs., Vol. III.
Greenwich—Berlin (Transit Circle) -	− 0 53 34·865	p. 490
Berlin—Alexandria - - -	− 1 5 58·942	491
Alexandria—Suez (Gill's Station) -	− 0 10 38·923	492
Suez—Aden (Gill's Station) -	− 0 49 43·750	493
Greenwich—Aden (Gill's Station) -	− 2 59 56·480	

Dr. Auwers' results are as follows:—

Berlin—Alexandria.

	h m s	Mean Error. s
Observed difference of local times -	− 1 5 58·988	± 0·042
Per. eq in obs. transits (Löw—Gill) -	+ ·051	± ·03
„ „ (Löw—Knorre) -	− ·005	± ·05
„ in obs. mirror signals (L—G) -	− ·021	± ·025
½ correc[tn] to sigs. given by Löw - -	− ·006	± ·01
„ „ Auwers -	− ·033	± ·01
½ retardation of sigs. on Morse recorder at Berlin - - - - -	− ·018	± ·005
Berlin—Alexandria - - - - -	− 1 5 59·020	± 0·078

Alexandria—Suez (Gill's Station).

	h m s	s
Observed difference of local times - -	− 0 10 39·027	± 0·076
Per. eq[n] in obs[ns] transits - - -	− ·051	± ·03
„ mirror sig[s] - - -	+ ·021	± ·025
Alexandria—Suez (Gill's Station) - -	− 0 10 39·057	± 0·085
Correction on account of per eqn. introduced for mirror sigs., as relays were employed in this operation.—(D.G.) - - - - - - -	− ·021	
Corrected result - -	− 0 10 39·078	± 0·082

Digitized by Google

Suez—Aden (Gill's Station).

	h	m	s	s
Observed difference of local times - -	− 0	49	43·763	± 0·113
Per. eq (L—G) in obs. transits - -			+ ·051	± ·03
„ in obs. mirror sig - - -			− 021	± ·025
	− 0	49	43·733	± 0·120

The result Alexandria—Aden, is free from Personal Equation in observing transits, whence, allowing for the correction introduced by me into Dr. Auwers' result for Alexandra—Suez, we have—

Alexandria—Aden - - -	− 1	0	22·811	± 0·139

And applying the longitude of Berlin, already quoted, to Dr. Auwers' results, we have, as the result of Lord Lindsay's Expedition—

GREENWICH—ADEN (GILL'S STATION).

				s
Auwers' reduction - - -	− 2	59	56·696	± 0·160
Copeland's, already quoted - - -	− 2	59	56·480	

Under the superintendence of Captain Heaviside, R.E., the two Longitude Stations (G. T. Survey, Heaviside's Station) and (Gill's Station) at Aden were connected by careful triangulation (G. T. Survey of India, Vol. IX., Appendix, Part II.), from which source the following results are extracted:—

	Latitude.			Longitude.		
	°	′	″	°	′	″
Longitude Station (G. T. Survey) -	N. 12	46	27·00	E. 44	58	57·45
Latitude Station „ -	12	46	27·00	44	58	57·65
Lord Lindsay's (Gill's) Station -	12	47	14·70	44	59	10·61

Hence, to reduce the above results of Series B. to the origin of the Aden—Cape Series (which was that of the G. T. Survey), we have to apply the correction + 0·877 to the results of Auwers and Copeland. Thus we obtain—

Longitude of G. T. Survey Station, Aden.

	h	m	s	Mean Error s
From sum of Series A. - -	− 2	59	55·833	± 0·154
From Series B., Auwers - - -			55·819	± 0·160
Copeland - -			55·603	

Digitized by Google

It is well remarked by Lord Crawford, in his preface to Vol. III. of the Dunecht Publications, "Given a large mass of observations . . . . it becomes possible so to "discuss them as to slightly modify the final deductions." It was this consideration which prompted him to publish the work in complete detail. It would be impossible to find two more capable or careful astronomers than Drs. Auwers and Copeland to discuss such a mass of observations, and no better course can be adopted than to take the mean of their results; and (as Dr. Copeland has not computed the *mean error*) to adopt the value of it found by Dr. Auwers, as the definitive result of Lord Lindsay's expedition, viz.:—

$$-\ 2^{h}\ 59^{m}\ 55^{s}\cdot711 \pm 0^{s}\cdot160$$

As the *mean errors* of Series A. and Series B. are practically identical, we take their mean as the definitive result for the longitude of Aden, of which the *probable error* is—

$$\pm 0\cdot6745 \times \frac{0^{s}\cdot16}{\sqrt{2}}$$

Whence we have the final definitive result—

	h m s	Prob. Error.
Aden, East of Greenwich - -	2 59 55·772	± 0·079
Cape, West of Aden (p. [58.]) -	1 46 1·015	± 0·027
Cape, Transit Circle, East of Greenwich	1 13 54·757	± 0·084

The weak point of this result is unquestionably the determination of the longitude Greenwich—Aden. Neither of the two series of operations on which it depends was executed with such refinements or precautions as are necessary for the determination of fundamental longitudes; nor indeed, so far as I know, were these operations planned with a view to the securing of more accuracy than would amply suffice for Transit of Venus purposes.

For refined purposes, the results of the British Transit of Venus party are vitiated by the extraordinary variations of the Personal Equation of the observers engaged in the determination of the Greenwich—Mokattam longitude, the results varying over a range of six-tenths of a second of time on the seven nights upon which Personal Equation was determined. For the longitude Mokattam—Suez there is no comparison of the Personal Equation of the observers before the expedition, and only a somewhat unsatisfactory one after it. In the determination of the longitude Suez—Aden a great part of the advantages, given by the refined instruments and methods and the excellent observations of Captains Campbell and Heaviside, R.E., are lost from the absence of a determination of Personal Equation after as well as before the Aden—Bombay operations; the necessity for such a check is illustrated by the actual change in the personal equation of the observers which I have already quoted. In the case of Lord Lindsay's expedition, the observations lay

Digitized by Google

no claim to high refinement. They were made throughout in the open air, with small portable instruments, which, in the case of Alexandria, were placed on the roof of a hotel, where the observer had to abstain from movement during each complete observation, otherwise the level was disturbed by the change of his position. At Aden and Alexandria the chronometers had to be carried a long distance between the observing station and the telegraph office; the observers were without personal assistance, and the crucial observations for time had often to be made under conditions of extreme fatigue, amounting on one or two occasions nearly to exhaustion, on part of the observers engaged. In fact, the character of the work was only such as it was possible to organise and execute *en route*, and the results fully realised the accuracy expected from them. But it is greatly to be desired that a refined determination of the longitude of Aden should be undertaken. That station is now the origin not only of the Cape of Good Hope and all East and South African longitudes, but also of the longitudes of India, Australia, and New Zealand. The problem is a much easier one than that of the connexion of Aden and the Cape, because the facility of transport would permit easy exchange of observers, and their meeting at an intermediate point for further check on Personal Equation; and besides there would be much less risk of loss of health to those engaged on the work.

Current Time of Transmission of Signals.

The reader is referred to the accompanying sketch map of the South African Telegraphic System in connexion with the following remarks. The exchange of signals for longitude through land lines about 1,100 miles* in length (which pass through a sparsely populated country, through many different kinds of climate, and districts liable to frequent thunderstorms, and occasionally to sudden floods), demands the most hearty co-operation of the telegraph officials as well as much patience on part of the Astronomers. It not unfrequently happened that when the weather was fine at both ends, and all promised well, telegraphic communication was entirely interrupted, and no longitude work could be done, or another route had to be rapidly arranged, or additional relays had to be introduced. For these reasons it was found impossible to equalise resistances and exchange relays in the systematic manner which is usual in the most refined longitude operations. Any attempt of this kind would have involved almost interminable delays, and have added so much to the cost of the operations as entirely to preclude its adoption. Indeed, apart from cost, the additional interval thus created between the determinations of Personal Equation would probably have introduced an additional element of uncertainty, exceeding the advantages which might be hoped for from the perfect equalisation on every occasion of the current time of the going and returning signals. The proof of freedom from systematic error on this account, must be looked for in the agreement of the longitude results notwithstanding the very various conditions of the various portions of the different lines, and in the fact that different lines with various numbers of relays introduced in them were employed.

---

* The coast line to Durban measures 1,146 miles.
The midland line to Durban measures 1,088 miles.

Digitized by Google

The following table gives the current time resulting from the exchange of signals (corrected for Personal Equation of the observers in sending and receiving signals) together with the names of the stations at which relays were introduced.

GW	denotes	George.
PE	„	Port Elizabeth.
FB	„	Fort Beaufort.
KW	„	King William's Town.
UA	„	Umtata.
PMB	„	Pietermaritzburg.
BW	„	Beaufort—West.
GR	„	Graff Rienet.
SE	„	Somerset—East.

Date.	Current Time Cape Durban.	Stations at which relays were introduced.
1881.	s	
June 17	+0·144	GW, PE, UA.
21	·229	BW, GR, SE, FB, UA.
22	·140	GW, PE, KWT, UA.
27	·100	GW, PE, UA.
Aug. 18	·155	GW, PE, UA.
19	·180	Coast line; relay stations not recorded.
26	·193	BW, GR, KWT, UA.
27	·198	Coast line; relay stations not recorded.
Sept. 3	·215	Coast line; UA, PMB.
19	·328	Coast line; relay stations not recorded.
Dec. 23	·215	Coast line; UA, PMB.
1882.		
Jan. 8	·218	Coast line; UA, PMB.
14	·198	BW, GW, FB, UA.
20	·199	Coast line; relay stations not recorded.
21	·178	Coast line; relay stations not recorded.
27	·183	Midland line; relay stations are recorded.
July 10	·181	GW, PE, FB, UA, PMB.
13	·206	BW, GR, FB, UA.

The following are the various current times in the exchange of signals between Durban and Aden:—

Digitized by Google

1881.	Current Time, Durban and Aden. s
Aug. 20	+1·467*
23	1·279
26	1·258
27	1·362
29	1·274
Sept. 2	1·301
3	1·315
13	1·281
18	1·379
19	1·276
22	1·274
23	1·272
26	1·286
28	1·232

Mean	+	1·291	*probable error*	± 0·007
Personal Eq^{n}	−	·125	„ „	± ·011
Current Time	+	1·166	„ „	± 0·013

The batteries employed were strictly similar at both ends of the Cable.

* Rejected for reasons stated on page [43].

Digitized by Google

CHAPTER IX.

LATITUDES OF DURBAN AND ADEN.

No attempt has been made to determine the latitude of the observing stations with high accuracy. The only available Altazimuth instrument was into the hands of Mr. Finlay, to enable him to determine the latitude at Aden, and to employ it in connexion with longitude determinations on the E. coast of Africa. To have detained Mr. Finlay at Durban for the purpose of making latitude determinations seemed unnecessary, as the future operations of the Geodetic Survey of South Africa (for the commencement of which I had then concluded arrangements between the Governments of the Cape Colony and Natal) would provide for accurate astronomical latitude determinations throughout Natal; and the establishment of an observatory in Durban (for which I had furnished the plans) provided for rigorous after determination of the latitude of a point not far from the site of the longitude operations at Durban.

Latitude of Durban.

The results of Mr. Finlay's observations of circum-meridian altitudes at Durban, are the following:—

1881.		Circle.	Latitude.
June 24	η Scorpii - -	L R	— 29 ° 51 ′ 33″·2
29	ν^2 Scorpii - -	R	29·3
„	20 Ophiuc. - -	L	
Nov. 27	φ Eridani - -	L R	25·9
„	θ Orionis - -	L R	25·5
„	ζ Orionis - -	L R	33·7
„	α Pictoris - -	L R	32·7
„	α Argûs - -	L R	30·0
Mean of N. stars - -			—29 51 29·83
S. „ - -			30·45
Latitude of Durban (Longitude Pillar)			—29 51 30·14

Digitized by Google

From a preliminary computation by Captain Morris, R.E., of a chain of triangles measured by Lieut. Laffan, R.E., connecting Zwartkop (the initial point and origin of the Geodetic Latitudes and Azimuths of the Survey) with stations near Durban, we have the following results :—

	Longitude East of Zwartkop.	Latitude South of Zwartkop.
	m s	′ ″
Transit Pier of longitude operations	3 5·76	15 58·16
Government Observatory, Durban	3 0·03	15 13·21
Durban Lighthouse	3 13·61	16 51·00

The latitude of Zwartkop, as determined by the Geodetic Survey Astronomical Observations (Talcott's method, Observer, Captain Morris, R.E.) is—

$$-\ 29^\circ\ 35'\ 33''{\cdot}32,$$

and this reduced to the longitude pier becomes—

$$-\ 29^\circ\ 51'\ 31''{\cdot}48$$

a result which is, of course, liable to be affected by abnormal local attraction.

Mr. Neison has kindly communicated to me the results of his observations for latitude of the Government Observatory, Durban, viz. :—

	− 29° 50′ 47″·40
Corrn. to Long. Pillar	−44·95
	− 29 51 32·35

And this must be accepted, for the present, as the most reliable determination of the three.

Latitude of Aden.

Mr. Finlay's Latitude determinations at Aden are the following, taken at the site of the longitude operations :—

Latitude of Aden (G. T. Survey Station).

1881.		By Stars South of the Zenith.		Mean.
			° ′ ″	
Aug. 30	α Gruis	+ 12 46 29·3		
Sept. 15	β Ceti	27·0		° ′ ″
„ 24	θ Ceti	30·8		+ 12 46 28·9
„ 25	θ Ceti	28·7		
		By Stars North of the Zenith.		
Sept. 15	β Cassiopeiæ	+ 12 46 23·0		
„ 24	γ Andromedæ	21·7		+ 12 46 23·0
„ 25	γ Andromedæ	24·4		
	Mean			+ 12 46 26·0

Digitized by Google

The latitude of the same station was also determined by Captain Heaviside, R.E., with a 10-inch theodolite. His results (G.T. Survey of India, Appendix to Part II. p. (111)) give for the mean resulting latitude—

$$+ 12^\circ\ 46'\ 27''$$

I should prefer to reject his observations of Polaris, made at ZD 76°, and without observations of a corresponding star S. of the Zenith, his result then becomes—

$$+ 12^\circ\ 46'\ 26''{\cdot}5$$

which agrees with Mr. Finlay's result far within limits of the probable error of either.

I cannot conclude this account without recording an expression of my grateful thanks :—

(1.) To Sir James Anderson, who most generously placed the submarine cables between Aden and Durban entirely at my disposal for this work.

(2.) To James Siveright, Esq., C.M.G., General Manager of Telegraphs at the Cape, for not only placing the whole South African system of land lines at my disposal, but also for making all the necessary arrangements, and supplying all necessary aid. Also for the exact execution of this work to Mr. J. P. Edwards, his able and active assistant, and to the officers in charge of the stations where relays had to be introduced.

(3.) To H. Carlisle, Esq., and C. Stacey, Esq., the Superintendents at Durban and Aden, not only for the efficient aid they rendered, but for their kindly hospitality to all engaged in the work.

(4.) To H. McEwen, Esq., and A. W. Prosser, Esq., members of the telegraph staff at Durban and Aden respectively, for the active share which they took in the work, for the intelligent interest which they displayed, and for the great enhancement of its value which resulted from their labours of love.

DAVID GILL.

An account, by Mr. Finlay, of the longitude operations connecting the secondary stations between Durban and Aden, carried out by him at my suggestion, forms Part III. of the present volume.

D. G.

Digitized by Google

SECTION I.

MEAN RIGHT ASCENSION

OF

389 TIME STARS

EMPLOYED IN THE LONGITUDE OPERATIONS,

DERIVED FROM OBSERVATIONS WITH THE TRANSIT CIRCLE.

12306. 400.--8/84. Wt.. 1124. E. & S.

Digitized by Google

SECTION I.

MEAN RIGHT ASCENSION OF 389 TIME STARS EMPLOYED IN THE LONGITUDE OPERATIONS.

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
1	4 Ceti	0 1 38·35	+3·073	93 15	6
2	B.A.C. 23	0 5 31·75	+3·056	118 28	5
3	7 Ceti	0 8 35·66	+3·056	109 38	5·4
4	Lalande 257	0 11 30·32	+3·049	109 43	6·7
5	*d* Piscium	0 14 28·61	+3·084	82 29	6·5
6	9 Ceti	0 16 45·85	+3·051	102 54	6
7	44 Piscium	0 19 18·11	+3·076	88 43	6
8	12 Ceti	0 23 57·93	+3·061	94 37	6
9	13 Ceti	0 29 7·35	+3·060	94 15	6
10	15 Ceti	0 31 59·48	+3·069	91 12	6·7
11	B.A.C. 174	0 34 38·80	+3·055	95 5	6
12	17 Ceti	0 38 11·15	+3·029	101 20	5
13	19 Ceti	0 44 9·90	+3·022	101 19	5·6
14	20 Ceti	0 46 55·59	+3·068	91 48	5
15	22 Ceti	0 50 3·39	+3·012	101 57	6·5
16	23 Ceti	0 52 46·32	+3·008	102 1	6
17	26 Ceti	0 57 41·62	+3·077	89 18	6·7
18	Lalande 1994	1 1 47·13	+3·008	100 25	5·8
19	34 Ceti	1 5 40·37	+3·054	92 53	6·5
20	39 Ceti	1 10 33·83	+3·051	93 10	6
21	42 Ceti	1 13 43·28	+3·065	91 8	6
22	B.A.C. 408	1 16 33·82	+3·105	85 53	6·5
23	47 Ceti	1 20 59·22	+2·960	103 41	6
24	48 Ceti	1 23 53·60	+2·877	112 17	5·6
25	*	1 26 51·84	+2·897	109 35	6
26	50 Ceti	1 30 10·66	+2·926	106 2	6·5
27	*ν* Piscium	1 35 14·33	+3·115	85 9	5·4
28	*o* Piscium	1 39 6·62	+3·156	81 27	4
29	54 Ceti	1 44 33·18	+3·181	79 33	6
30	*ξ* Piscium	1 47 23·72	+3·099	87 25	4
31	56 Ceti	1 51 5·85	+2·807	113 7	5
32	112 Piscium	1 53 57·82	+3·101	87 29	6
33	61 Ceti	1 57 42·71	+3·062	90 56	6·7
34	Lalande 3979	2 3 7·07	+3·054	108 22	6·7
35	*ξ* Ceti	2 6 41·58	+3·081	81 43	5
36	67 Ceti	2 11 2·84	+2·984	97 0	6
37	B.A.C. 737	2 17 5·81	+2·732	114 23	5
38	*ρ* Ceti	2 20 12·04	+2·898	102 51	5
39	*σ* Ceti	2 26 26·82	+2·848	105 48	5
40	*ν* Ceti	2 29 37·86	+3·145	84 55	4·5
41	*δ* Ceti	2 33 23·02	+3·070	90 11	4
42	*μ* Ceti	2 38 30·62	+3·217	80 24	4·5
43	Lalande 5211	2 42 13·87	+2·873	102 59	6·7
44	τ^2 Eridani	2 45 38·41	+2·725	111 31	5·4
45	Lalande 5424	2 49 51·95	+3·198	82 6	6
46	*λ* Ceti	2 53 20·25	+3·209	81 34	5·6
47	ρ^3 Eridani	2 58 25·84	+2·940	98 4	5
48	Lalande 5759	3 0 40·40	+3·182	96 33	6·5
49	94 Ceti	3 6 42·07	+3·045	91 40	5·6
50	*ζ* Eridani	3 10 3·22	+2·912	99 47	4·5
51	Lacaille 1051	3 13 6·59	+2·650	112 58	5·6
52	Lalande 6248	3 16 12·13	+2·622	114 4	6·5
53	*o* Tauri	3 18 24·60	+3·226	81 24	4·3
54	Lalande 6476	3 23 58·83	+2·831	103 7	6
55	τ^5 Eridani	3 28 31·86	+2·646	112 2	4·5

Digitized by Google

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
56	20 Eridani - - -	3 30 52·10	+2·730	107 53	5
57	22 Eridani - - -	3 34 44·90	+2·967	95 36	5·6
58	24 Eridani - - -	3 38 27·91	+3·043	91 34	6·5
59	τ^6 Eridani - - -	3 41 43·66	+2·592	113 37	4
60	30 Eridani - - -	3 46 48·98	+2·961	95 44	6·5
61	Lalande 7273 - -	3 49 40·42	+2·824	102 27	6
62	Lalande 7384 - -	3 53 0·53	+2·958	95 48	6
63	γ Tauri - - -	3 56 49·61	+3·186	84 21	4
64	Lalande 7685 - -	4 1 16·93	+2·687	108 23	6·7
65	o Eridani - - -	4 6 3·48	+2·923	97 10	4·5
66	μ Tauri - - -	4 9 4·38	+3·253	81 25	5
67	ξ Eridani - - -	4 17 45·38	+2·988	94 2	5·6
68	44 Eridani - - -	4 22 23·03	+3·097	88 53	5·6
69	45 Eridani - - -	4 25 47·46	+3·066	90 19	5·6
70	W. B. IV–585 - -	4 28 29·90	+2·873	99 13	5·6
71	Lalande 8736 - -	4 31 36·82	+3·014	92 43	6·5
72	54 Eridani - - -	4 35 14·19	+2·622	109 55	5
73	Lalande 8935 - -	4 38 22·32	+2·881	98 44	6·5
74	Lalande 9045 - -	4 42 15·63	+2·684	107 10	6·5
75	π^4 Orionis - - -	4 44 52·03	+3·191	84 36	4·5
76	π^5 Orionis - - -	4 48 3·20	+3·122	87 46	4
77	Lalande 9293 - -	4 50 32·58	+2·953	95 22	6
78	64 Eridani - - -	4 54 24·00	+2·784	102 43	6
79	B.A.C. 1559 - -	4 57 19·45	+2·430	116 27	5
80	ι Orionis - - -	5 1 24·21	+3·262	81 40	6
81	λ Eridani - - -	5 3 27·02	+2·870	98 55	4
82	ι Leporis - - -	5 6 44·78	+2·796	102 1	4·5
83	τ Orionis - - -	5 11 49·71	+2·913	96 59	4
84	o Orionis - - -	5 15 41·20	+3·062	90 30	5·6
85	Lalande 10145 - -	5 18 34·25	+3·113	88 16	5·6
86	Lalande 10325 - -	5 23 27·85	+2·991	93 33	6·5
87	υ Orionis - - -	5 26 10·49	+2·902	97 23	5
88	c Orionis - - -	5 29 30·96	+2·959	94 55	5
89	ι Orionis - - -	5 29 36·70	+2·933	96 0	3·5
90	σ Orionis - - -	5 32 46·33	+3·011	92 40	4
91	b Orionis - - -	5 36 19·34	+3·106	88 35	6
92	γ Leporis - - -	5 39 30·09	+2·522	112 29	4
93	Lalande 11047 - -	5 43 29·29	+3·304	80 10	6
94	δ Leporis - - -	5 46 12·20	+2·564	110 53	4
95	η Leporis - - -	5 50 59·07	+2·735	104 12	4·3
96	Lalande 11382 - -	5 54 6·15	+3·001	93 5	6·5
97	66 Orionis - - -	5 58 41·14	+3·170	85 50	6
98	B.A.C. 1965 - -	6 1 34·37	+2·503	113 6	6
99	B.A.C. 1994 - -	6 6 4·34	+2·920	96 31	5
100	5 Monocerotis - -	6 9 3·11	+2·927	96 14	5·4
101	7 Monocerotis - -	6 13 58·85	+2·891	97 46	6
102	8 Monocerotis - -	6 17 27·72	+3·181	85 21	5·4
103	10 Monocerotis - -	6 22 4·99	+2·964	94 41	5
104	13 Monocerotis - -	6 26 28·08	+3·246	82 34	5
105	ξ^2 Can. Maj. - - -	6 30 4·08	+2·514	112 52	5
106	15 Monocerotis - -	6 34 25·45	+3·306	80 0	4
107	ξ Geminorum - -	6 38 36·63	+3·378	76 59	4
108	18 Monocerotis - -	6 41 39·32	+3·131	87 27	5
109	θ Can. Maj. - - -	6 48 39·69	+2·798	101 53	4·5
110	B.A.C. 2291 - -	6 53 43·34	+2·459	115 15	6·5
111	19 Monocerotis - -	6 57 0·25	+2·981	94 4	6·5
112	Lalande 13811 - -	7 1 5·43	+2·820	101 6	6
113	20 Monocerotis - -	7 4 19·05	+2·982	94 3	6·5
114	26 Can. Maj. - - -	7 7 20·07	+2·454	115 44	6
115	B.A.C. 2405 - -	7 11 48·71	+2·406	117 40	6

Digitized by Google

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
116	B.A.C. 2433 - -	7 15 57·05	+3·161	89 36	6
117	ϵ Can. Min. - - -	7 19 8·59	+3·284	80 29	6
118	B.A.C. 2470 - -	7 22 15·96	+2·823	101 18	6·7
119	26 Monocerotis - -	7 35 33·69	+2·871	99 16	4·5
120	τ Navis - - -	7 39 1·81	+2·409	118 40	4
121	o Puppis - - -	7 43 8·37	+2·495	115 38	5
122	9 Argûs - - -	7 46 15·62	+2·784	103 34	6
123	B.A.C. 2636 - -	7 49 3·57	+3·265	80 49	6
124	27 Monocerotis - -	7 53 47·43	+3·005	93 20	5·6
125	B.A.C. 2679 - -	7 56 44·36	+3·282	79 43	6·5
126	ζ Monocerotis - -	8 2 36·76	+3·020	92 38	5·4
127	β Cancri - - -	8 10 3·66	+3·258	80 27	4·3
128	W.B. VIII—486 - -	8 19 51·86	+2·908	98 34	7·6
129	B.A.C. 2846 - -	8 22 50·60	+2·550	115 44	6
130	B.A.C. 2868 - -	8 26 10·05	+2·699	109 9	6
131	δ Hydræ - - -	8 31 21·31	+3·186	83 53	4
132	6 Hydræ - - -	8 34 23·15	+2·850	102 2	6
133	B.A.C. 2954 - -	8 37 49·72	+2·950	96 48	6
134	15 Hydræ - - -	8 45 43·49	+2·955	96 43	6
135	B.A.C. 3082 - -	8 56 1·72	+2·600	116 11	6
136	κ Cancri - - -	9 1 18·02	+3·258	78 51	5
137	θ Hydræ - - -	9 8 10·37	+3·117	87 11	4
138	Lalande 19241 - -	9 42 17·99	+2·985	96 41	7·6
139	13 Sextantis - - -	9 57 58·53	+3·118	86 13	6
140	A Leonis - - -	10 1 35·35	+3·196	79 25	5
141	λ Hydræ - - -	10 4 47·22	+2·939	101 44	4
142	21 Sextantis - - -	10 8 12·60	+2·992	97 24	6
143	22 Sextantis - - -	10 11 43·07	+2·993	97 27	6·5
144	25 Sextantis - - -	10 17 25·64	+3·038	93 27	6
145	μ Hydræ - - -	10 20 20·14	+2·909	106 12	4
146	ρ Leonis - - -	10 26 32·68	+3·165	80 4	4
147	36 Sextantis - - -	10 39 1·50	+3·098	86 53	6
148	l Leonis - - -	10 43 0·14	+3·160	78 49	6
149	p^1 Leonis - - -	10 55 45·44	+3·061	91 49	5
150	χ Leonis - - -	10 58 52·67	−3·122	82 1	5
151	β Crateris - - -	11 5 48·35	+2·945	112 9	4
152	φ Leonis - - -	11 10 36·73	+3·058	92 58	5·4
153	79 Leonis - - -	11 17 59·01	+3·083	87 56	5·6
154	k Crateris - - -	11 21 9·88	+3·026	101 40	6
155	e Leonis - - -	11 24 14·12	+3·065	92 19	5
156	θ Crateris - - -	11 30 38·74	+3·045	99 7	4·5
157	Lalande 22102 - -	11 33 49·72	+3·035	103 49	6
158	A^1 Virginis - - -	11 41 48·05	+3·090	81 5	5·6
159	η Crateris - - -	11 49 57·09	+3·055	106 27	6
160	Lalande 22585 - -	11 54 38·03	+3·067	99 44	6·7
161	B.A.C. 4077 - -	11 59 54·22	+3·073	92 26	6·7
162	Lalande 22818 - -	12 3 59·52	+3·070	83 32	6
163	12 Virginis - - -	12 7 22·36	+3·065	79 4	6
164	Lalande 23006 - -	12 10 55·15	+3·091	106 2	6
165	η Virginis - - -	12 13 49·06	+3·067	90 0	4
166	6 Corvi - - -	12 17 9·59	+3·118	114 10	6·5
167	B.A.C. 4200 - -	12 21 45·23	+3·082	93 55	6·7
168	Piazzi XII–111 - -	12 25 31·60	+3·085	94 23	6·7
169	B.A.C. 4238 - -	12 28 27·66	+3·049	81 36	7
170	χ Virginis - - -	12 33 6·30	+3·097	97 18	5
171	ψ Virginis - - -	12 48 9·95	+3·116	98 52	5
172	44 Virginis - - -	12 53 31·74	+3·090	93 10	6
173	Lalande 24277 - -	12 57 23·78	+3·193	109 57	6
174	B.A.C. 4382 - -	13 0 10·29	+3·161	104 16	6·5
175	θ Virginis - - -	13 3 47·34	+3·103	94 52	4·5

Digitized by Google

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
176	54 Virginis - - -	13 7 5·23	+3·200	108 12	6·5
177	58 Virginis - - -	13 11 13·15	+3·144	99 55	6
178	B.A.C. 4462 - -	13 14 33·19	+3·032	84 33	7
179	66 Virginis - - -	13 18 21·55	+3·109	94 32	6
180	72 Virginis - - -	13 24 13·26	+3·122	95 50	6·7
181	*h* Virginis - - -	13 26 42·04	+3·156	99 33	6·5
182	81 Virginis - - -	13 31 21·18	+3·139	97 16	7
183	*m* Virginis - - -	13 35 22·04	+3·149	98 4	6
184	86 Virginis - - -	13 39 35·89	+3·191	101 49	6
185	89 Virginis - - -	13 43 24·40	+3·257	107 31	5
186	*p* Virginis - - -	13 48 35·51	+3·082	90 53	6·5
187	47 Hydræ - - -	13 51 50·61	+3·356	114 22	6
188	*τ* Virginis - - -	13 55 35·44	+3·048	87 52	4·5
189	95 Virginis - - -	14 0 25·22	+3·176	98 46	6
190	96 Virginis - - -	14 2 40·21	+3·190	99 45	6·5
191	*κ* Virginis - - -	14 6 32·92	+3·192	99 43	4·5
192	*ι* Virginis - - -	14 9 46·50	+3·137	95 25	4
193	λ Virginis - - -	14 12 40·25	+3·239	102 49	4
194	υ^2 Virginis - - -	14 15 50·62	+3·092	91 26	6
195	B.A.C. 4773 - -	14 18 16·03	+2·988	83 38	5·5
196	*φ* Virginis - - -	14 22 4·29	+3·085	91 41	5
197	Lalande 26492 - -	14 24 48·07	+3·000	84 42	6·7
198	109 Virginis - - -	14 40 14·00	+3·033	87 35	4
199	58 Hydræ - - -	14 43 18·16	+3·526	117 27	5
200	12 Libræ - - -	14 47 25·54	+3·472	114 9	6
201	ξ^2 Libræ - - -	14 50 18·69	+3·247	100 54	6
202	δ Libræ - - -	14 54 36·89	+3·203	98 1	5
203	110 Virginis - - -	14 56 53·30	+3·031	87 26	5
204	*ν* Libræ - - -	14 59 59·39	+3·340	105 47	5
205	*ι* Libræ - - -	15 5 26·37	+3·412	109 19	5·4
206	3 Serpentis - - -	15 9 16·41	+2·980	84 36	6
207	32 Libræ - - -	15 21 32·76	+3·373	106 17	4
208	ζ^3 Libræ - - -	15 23 57·63	+3·375	106 12	6
209	37 Libræ - - -	15 27 40·48	+3·251	99 38	5
210	41 Libræ - - -	15 32 3·61	+3·438	108 53	5·6
211	*κ* Libræ - - -	15 35 5·46	+3·451	109 17	5
212	*ψ* Serpentis - - -	15 38 2·72	+3·018	87 6	6
213	*ω* Serpentis - - -	15 44 17·06	+3·023	87 26	5·6
214	λ Libræ - - -	15 46 25·61	+3·475	109 48	4
215	48 Libræ - - -	15 51 31·53	+3·353	103 55	5
216	50 Libræ - - -	15 54 22·21	+3·235	98 4	6
217	51 Libræ - - -	15 57 49·49	+3·297	101 2	4·5
218	11 Scorpii - - -	16 0 59·93	+3·328	102 24	6
219	c^2 Scorpii - - -	16 4 58·49	+3·685	117 36	5
220	18 Scorpii - - -	16 9 9·21	+3·240	98 3	6·5
221	Lalande 29689 - -	16 12 17·32	+3·383	104 35	6·7
222	*ψ* Ophiuchi - - -	16 17 8·44	+3·505	109 45	5
223	*χ* Ophiuchi - - -	16 20 7·68	+3·471	108 11	5
224	*φ* Ophiuchi - - -	16 24 19·67	+3·431	106 20	5
225	28 Herculis - - -	16 26 44·34	+2·949	84 13	5·5
226	12 Ophiuchi - - -	16 30 6·43	+3·117	92 3	6·5
227	14 Ophiuchi - - -	16 35 40·93	+3·042	88 35	6
228	25 Scorpii - - -	16 39 34·24	+3·666	115 18	6
229	20 Ophiuchi - - -	16 43 15·06	+3·308	100 34	5
230	23 Ophiuchi - - -	16 48 14·09	+3·206	95 57	5
231	Lalande 30831 - -	16 51 55·51	+3·408	104 40	6·7
232	30 Ophiuchi - - -	16 54 47·10	+3·163	94 2	5
233	Lalande 31109 - -	17 0 42·37	+3·336	101 29	7·6
234	Lalande 31210 - -	17 4 3·24	+3·361	102 32	6·7
235	37 Ophiuchi - - -	17 6 51·24	+2·826	79 16	5

Digitized by Google

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
236	41 Ophiuchi - - -	17 10 30·15	+3·080	90 18	5
237	40 Ophiuchi - - -	17 13 52·36	+3·575	110 59	5
238	Lalande 31606 - -	17 17 35·11	+3·586	111 19	6·7
239	B.A.C. 5890 - -	17 20 19·06	+3·188	94 59	5·4
240	51 Ophiuchi - - -	17 24 9·30	+3·657	113 52	5
241	57 Ophiuchi - - -	17 31 22·62	+3·261	98 3	5
242	o Serpentis - - -	17 34 43·57	+3·375	102 48	5·4
243	Lalande 32325 - -	17 37 21·68	+3·237	97 1	7·6
244	γ Ophiuchi - - -	17 41 55·54	+3·009	87 15	4
245	Lalande 32633 - -	17 45 50·37	+3·101	91 12	7·6
246	B.A.C. 6060 - -	17 48 55·00	+3·527	108 47	6
247	Lalande 32923 - -	17 53 17·69	+3·185	94 48	6·1
248	7 Sagittarii - - -	17 55 33·54	+3·676	114 17	6
249	B.A.C. 6111 - -	17 57 52·59	+3·679	114 24	7
250	Lalande 33262 - -	18 1 36·93	+2·868	81 17	5
251	μ^1 Sagittarii - - -	18 6 38·78	+3·588	111 5	4
252	Lalande 33596 - -	18 10 6·40	+3·019	87 40	7·6
253	Rumker 6386 - -	18 13 24·30	+2·904	82 47	6·5
254	21 Sagittarii - - -	18 18 15·75	+3·574	110 36	5
255	B.A.C. 6279 - -	18 22 24·88	+3·421	104 39	5·4
256	61 Serpentis - - -	18 25 48·31	+3·098	91 5	6·7
257	B.A.C. 6324 - -	18 28 25·53	+3·333	101 4	6·5
258	B.A.C. 6347 - -	18 31 47·62	+3·585	111 9	6·7
259	B.A.C. 6367 - -	18 37 2·43	+3·268	98 24	5
260	B.A.C. 6388 - -	18 40 51·65	+3·185	94 53	5·4
261	30 Sagittarii - - -	18 43 41·28	+3·612	112 18	6
262	ν^1 Sagittarii - - -	18 46 59·05	+3·626	112 53	4·5
263	θ Serpentis - - -	18 50 18·19	+2·981	85 57	4·5
264	B.A.C. 6488 - -	18 54 45·45	+3·433	105 28	6·7
265	15 Aquilæ - - -	18 58 40·67	+3·168	94 13	6·5
266	19 Aquilæ - - -	19 3 10·20	+2·940	84 7	6·5
267	20 Aquilæ - - -	19 6 13·36	+3·257	98 8	6·5
268	d Sagittarii - - -	19 10 40·26	+3·516	109 10	5
269	υ Sagittarii - - -	19 14 54·67	+3·441	106 11	5·4
270	ν Aquilæ - - -	19 20 25·87	+3·071	89 55	5·6
271	e Aquilæ - - -	19 24 26·42	+3·139	93 3	5·6
272	B.A.C. 6694 - -	19 27 22·85	+3·629	114 7	7
273	κ Aquilæ - - -	19 30 29·32	+3·231	97 18	5
274	47 Aquilæ - - -	19 36 58·07	+2·824	78 27	6
275	υ Aquilæ - - -	19 39 52·61	+2·907	82 11	6
276	51 Aquilæ - - -	19 44 13·90	+3·308	101 4	6
277	η Aquilæ - - -	19 46 24·64	+3·056	89 18	4
278	β Aquilæ - - -	19 49 28·06	+2·946	83 54	4
279	63 Sagittarii - - -	19 55 18·56	+3·365	103 59	6
280	τ Aquilæ - - -	19 58 19·52	+2·932	83 4	5·5
281	Lalande 38458 - -	20 1 45·26	+3·217	97 7	6·7
282	ξ Capricorni - - -	20 5 48·03	+3·336	102 58	6·7
283	α^1 Capricorni - - -	20 11 3·03	+3·330	102 53	4·5
284	B.A.C. 7014 - -	20 17 16·91	+2·977	85 2	6
285	ρ Capricorni - - -	20 22 4·27	+3·432	108 14	5
286	Wash. 8892 - -	20 24 24·18	+3·372	105 36	6·7
287	ϵ Delphini - - -	20 27 31·64	+2·866	79 6	4
288	Lalande 40029 - -	20 37 45·16	+2·993	85 2	7·6
289	ϵ Aquarii - - -	20 41 13·98	+3·251	99 57	4·5
290	ω Capricorni - - -	20 44 43·02	+3·594	117 22	4·5
291	19 Capricorni - - -	20 48 4·30	+3·404	108 24	6
292	11 Aquarii - - -	20 54 17·81	+3·162	95 13	6
293	η Capricorni - - -	20 57 37·85	+3·427	110 20	5
294	ν Aquarii - - -	21 3 6·60	+3·269	101 53	4·5
295	α Equulei - - -	21 9 52·50	+2·997	85 15	4

Digitized by Google

No.	Name.	Mean R.A. 1881·0.	Prec.	Approx. N.P.D. 1881·0.	Mag.
		h m s	s	° ′	
296	16 Aquarii - - -	21 14 49·94	+3·152	95 6	6
297	ζ Capricorni - - -	21 19 52·31	+3·438	112 57	4
298	Lalande 41765 - -	21 23 18·77	+3·375	109 41	6·7
299	8 Pisc. Aust. - - -	21 29 16·82	+3·484	116 43	5·5
300	ξ Aquarii - - -	21 31 24·98	+3·194	98 23	5
301	41 Capricorni - - -	21 35 14·04	+3·421	113 48	5
302	46 Capricorni - - -	21 38 39·48	+3·218	99 38	5·5
303	27 Aquarii - - -	21 41 11·93	+3·045	87 52	5·5
304	Lalande 42574 - -	21 45 5·22	+3·380	109 11	6·7
305	B.A.C. 7628 - -	21 47 57·39	+3·135	94 52	6
306	B.A.C. 7649 - -	21 52 5·46	+3·357	111 47	6·7
307	B.A.C. 7665 - -	21 55 38·74	+3·305	108 30	6·7
308	ι Aquarii - - -	22 0 0·51	+3·246	104 28	4·5
309	e Aquarii - - -	22 4 15·65	+3·213	102 10	5·6
310	41 Aquarii - - -	22 7 43·53	+3·323	111 41	6
311	θ Aquarii - - -	22 10 33·20	+3·169	98 24	4·5
312	γ Aquarii - - -	22 15 30·57	+3·093	92 0	4
313	π Aquarii - - -	22 19 12·01	+3·065	89 14	5
314	σ Aquarii - - -	22 24 20·86	+3·182	101 19	5
315	υ Aquarii - - -	22 28 10·93	+3·278	111 21	5·6
316	κ Aquarii - - -	22 31 35·57	+3·116	94 51	6
317	20 Pisc. Aust. - - -	22 39 0·59	+3·297	115 52	6
318	τ^2 Aquarii - - -	22 43 17·38	+3·185	104 13	4
319	λ Aquarii - - -	22 46 24·33	+3·133	98 13	4
320	ρ Pegasi - - -	22 49 14·25	+3·015	81 50	5·5
321	2 Piscium - - -	22 53 21·51	+3·071	89 41	6·5
322	h^1 Aquarii - - -	22 58 57·39	+3·125	98 22	6·5
323	c^2 Aquarii - - -	23 3 5·97	+3·205	111 49	4
324	59 Pegasi - - -	23 5 43·73	+3·028	81 56	5·5
325	φ Aquarii - - -	23 8 9·49	+3·128	96 42	5
326	γ Piscium - - -	23 10 59·76	+3·059	87 23	4
327	B.A.C. 8119 - -	23 13 13·74	+3·100	95 47	6
328	b^1 Aquarii - - -	23 16 43·12	+3·169	110 47	4·5
329	κ Piscium - - -	23 20 49·93	+3·070	89 26	5·4
330	Lalande 45980 - -	23 23 22·90	+3·092	95 11	6·7
331	16 Piscium - - -	23 30 18·88	+3·069	88 34	6
332	ι Piscium - - -	23 33 49·77	+3·059	85 2	4·5
333	i^1 Aquarii - - -	23 38 1·67	+3·117	108 56	5
334	δ Sculptoris - - -	23 42 43·48	+3·128	118 48	5
335	22 Piscium - - -	23 45 52·27	+3·070	87 44	6
336	B.A.C. 8311 - -	23 48 41·19	+3·074	90 34	6·5
337	ω Piscium - - -	23 53 12·04	+3·068	83 48	4
338	2 Ceti - - -	23 57 38·54	+3·078	108 2	4·5

Digitized by Google

Digitized by Google

SECTION II.

MEAN RIGHT ASCENSION

OF

87 SOUTHERN CIRCUMPOLAR STARS

EMPLOYED IN THE LONGITUDE OPERATIONS,

DERIVED FROM OBSERVATIONS WITH THE TRANSIT CIRCLE.

ORIGINALLY CIRCULATED FOR USE OF THE OBSERVERS OF THE TRANSIT OF VENUS IN 1882.

Digitized by Google

Catalogue of 87 Southern Circumpolar Stars for 1882·0, from Observations made at the Royal Observatory, Cape of Good Hope, in the year 1881.

The following Southern Circumpolar Stars were selected for determining Azimuth in the recent operations which connect the longitudes of Aden and the Cape of Good Hope.

These stars have been regularly observed with the Transit-circle of the Observatory during the year 1881, and I have thought it desirable to publish the resulting Right Ascensions without delay for the use of Expeditions to the Southern Hemisphere in connection with the Transit of Venus of the present year.

The North-polar Distances are taken from Mr. Stone's Catalogue of 12,441 stars for 1880.

The Proper Motions have also generally been taken from the same work; when not given by Mr. Stone they have been independently investigated. When printed within brackets, the Proper Motions either depend on an interval not exceeding ten years, or the earlier observations are not sufficiently numerous or accordant to give a very precise value; but when any value is given it is to be understood that there is no doubt of the existence of a Proper Motion approximately of the amount stated.

The magnitudes are taken from the *Uranometria Argentina*, excepting those printed within brackets, which are taken from Mr. Stone's Cape Catalogue.

To reduce the Right Ascensions to a homogeneous system it was necessary, in the first place, to compare the personal errors of the four observers.

All the observations were made with a reversing prism conveniently mounted on the eye-piece between it and the observer's eye. By rotation of the prism the observer could make the star appear to move through the field from right to left, or from left to right at pleasure, and all the transits were observed over half the wires with the apparent motion from right to left, and over the other half from left to right; or if the wires were unsymmetrically observed, both sets were reduced to the middle wire, and the mean of the two sets was taken. A rigorous discussion showed that, by this arrangement, the difference of personal equation for transits above and transits below the pole was completely eliminated.

But one of the observers, Mr. Freeman, proved to have a very considerable personal equation, which had already been remarked by Mr. Stone (Cape Observations 1871–3, Introduction p. ix., and Cape Observations 1874, pp. viii. and ix.). Mr. Freeman is an experienced observer, but he systematically observes slow-moving stars too late, and appears to allow them to pass the centre of the wire about one second of arc before noting the time of transit, at least I find, by an elaborate comparison of his habit of observing, that his observations of circumpolar stars require the correction

$$+ 0^s\cdot09 - 0^s\cdot0697 \sec. \delta$$

and that this reduces his observations to very precise agreement with the mean of the other observers. The relative personal equations of the other observers for circumpolar stars are very trifling.

In the absence of bright stars near the South Pole, the Right Ascensions of Circumpolar Stars determined at this Observatory must depend fundamentally on the Right Ascensions of such circumpolars as can be observed at both culminations in the winter months.

If, therefore, the Transit-circle has a systematic tendency, in these months, to change its azimuth in one direction between the evening and morning observations, the whole system of fundamental azimuth stars will be affected by a systematic error, and this

Digitized by Google

error will correspond with an error in the computed azimuth of the Transit-circle which will be a function of the Right Ascension, and may be expressed by

$$a + b \sin \alpha + c \cos \alpha + \&c.$$

To examine this point I have discussed the difference of Right Ascensions deduced from observations above and below pole, where the observations occur between sunset and midnight, and where therefore the upper and lower culminations occur at different seasons of the year.

Equations were formed of the type

$$a + b \sin \alpha + c \cos \alpha = \frac{\alpha' - \alpha_,}{f' - f_,}$$

where

α = The Star's approximate Right Ascension.

α' & $\alpha_,$ = The Star's R.A. deduced respectively from upper and lower transits.

f' & $f_,$ = The Star's Azimuth factor at upper and lower transit respectively.

The weights of these equations were computed by the formula

$$p = \frac{n' n_,}{n' + n_,}$$

where n' and $n_,$ are the number of observations above and below pole.

The solution of these equations by the method of least squares, having regard to the weight of each, gave the values of a, b, and c with their *mean errors* as follows:—

$$a = -\ 0^s\cdot0027 \pm 0^s\cdot0033$$
$$b = -\ 0\cdot0035 \pm 0\cdot0047$$
$$c = -\ 0\cdot0042 \pm 0\cdot0047$$

and the *mean error* of an equation of weight unity $\pm\ 0^s\cdot0414$.

It is obvious therefore that the observations are sufficiently accurate, and that there is no evidence of systematic diurnal change in the Azimuth of the instrument.

A more complete and definitive Catalogue of Circumpolar Stars will afterwards be published, but it is hoped that the present Catalogue will be found amply sufficient for the purposes for which it is intended.

DAVID GILL.

Royal Observatory, Cape of Good Hope,
1882, April 16.

Digitized by Google

No. in Stone.	Star's Name.	Magnitude.	Mean R.A. 1882·0.	No. of Obs.	Precess.	Proper Motion.	Mean N.P.D. 1882·0 (from Stone).	Precess.	Proper Motion.
			h m s		s	s	° ′ ″	″	″
20	Lacaille 9745 -	(7·0)	0 2 25·70	5	+ 2·827		176 41 46·36	−20·05	
37	γ^3 Octantis - -	5·6	0 4 39·52	6	+ 2·855	− 0·014	172 52 49·75	−20·05	+ 0·05
100	o Octantis - -	(6·3)	0 12 47·83	7	− 1·286	+ 0·012	179 1 8·49	−20·02	0·00
146	β Hydri - - -	2·7	0 19 31·71	9	+ 2·541	+ 0·720	167 55 8·08	−19·98	− 0·32
300	Lacaille 248 -	(6·3)	0 39 48·25	11	− 0·546		176 20 52·38	−19·75	
330	λ Hydri - - -	5·6	0 44 29·65	8	+ 2·070	+ 0·048	165 33 58·68	−19·68	+ 0·01
645	Lacaille 505 -	6·3	1 32 53·25	10	+ 0·334	− 0·007	169 6 14·31	−18·43	+ 0·13
725	Lacaille 634 -	6·1	1 44 20·91	12	− 4·179	+ 0·010	175 21 54·55	−18·01	
755	Lacaille 606 -	6·1	1 48 54·78	5	− 0·687	− 0·026	170 45 34·60	−17·83	
804	Lacaille 637 -	6·3	1 56 4·51	5	− 0·241	(+0·050)	168 55 32·15	−17·54	
899	Lacaille 709 -	6·7	2 10 22·64	10	− 0·092		167 10 40·62	−16·90	
1117	Lacaille 1029 -	(7·0)	2 38 23·71	16	− 9·893		176 14 21·34	−15·45	
1211	ν Hydri - - -	5·1	2 51 14·90	8	− 0·453	− 0·014	165 32 57·59	−14·71	
1359	Lacaille 1105 -	6·3	3 11 35·31	4	− 2·247		169 26 13·00	−13·44	
1396	Lacaille 1848 -	(7·0)	3 15 7·28	6	−39·286		178 38 24·46	−13·22	
1496	Lacaille 1222 -	(6·3)	3 31 33·76	10	− 1·950		168 0 53·65	−12·10	
1630	Lacaille 1414 -	(7·0)	3 45 30·41	7	− 9·922		175 6 12·23	−11·11	
1768	Lacaille 1592 -	6·5	4 4 30·70	9	−12·171		175 36 28·53	− 9·68	
1785	Lacaille 1444 -	6·8	4 8 2·90	9	− 2·972	+ 0·006	168 56 54·69	− 9·41	
2006	Lacaille 1839 -	(7·0)	4 34 17·36	14	−17·443		176 31 42·75	− 7·33	
2210	Lacaille 1752 -	6·0	4 58 35·34	6	− 1·779	(+0·006)	165 7 5·24	− 5·31	
2330	Lacaille 1921 -	5·8	5 12 20·83	4	− 7·034		172 37 31·38	− 4·14	
2452	Lacaille 2066 -	6·8	5 25 28·41	7	− 9·483		173 59 23·64	− 3·01	
2653	Lacaille 2138 -	5·8	5 46 35·18	7	− 4·954	+ 0·034	170 33 23·68	− 1·17	− 0·93
2724	Lacaille 2296 -	6·1	5 53 4·73	21	−11·725		174 50 22·57	− 0·61	
2758	Lacaille 2210 -	5·5	5 58 14·93	5	− 4·057	− 0·006	169 22 49·28	− 0·15	
2901	* - -	(7·3)	6 12 6·64	11	−43·481		178 21 26·31	+ 1·06	
2985	Lacaille 2426 -	7·1	6 20 42·73	5	− 6·406		172 0 13·01	+ 1·81	
3290	ζ Mensæ - -	5·8	6 49 50·66	9	− 4·889	− 0·005	170 41 15·85	+ 4·33	
3713	Lacaille 3274 -	6·7	7 27 53·80	20	−19·339		176 50 1·17	+ 7·50	
4068	Lacaille 3238 -	6·8	7 56 54·81	7	− 4·543		171 17 20·93	+ 9·79	
4191	A Octantis - -	(7·0)	8 5 50·53	16	−41·176	− 0·014	178 31 25·43	+10·47	− 0·02
4389	θ Chamæleontis -	4·7	8 24 9·46	5	− 1·649	− 0·050	167 6 12·45	+11·80	− 0·01
4486	Lacaille 3537 -	6·2	8 31 16·20	6	− 3·257		170 31 36·79	+12·30	
4967	ζ Octantis - -	5·7	9 13 33·54	19	− 7·474	− 0·080	175 11 19·44	+15·00	− 0·02
5146	ι Chamæleontis -	5·8	9 28 2·06	7	− 1·730	− 0·060	170 16 37·35	+15·81	− 0·08
5252	ζ Chamæleontis -	5·5	9 37 18·44	7	− 1·542	+ 0·001	170 24 38·99	+16·29	+ 0·03
5351	Lacaille 4169 -	7·1	9 47 32·55	14	− 6·147		175 28 11·67	+16·79	
5501	Lacæleontis -	6·0	10 3 49·30	5	− 1·346		171 38 37·32	+17·53	
5911	Lacaille 4510 -	6·9	10 37 48·39	11	− 2·862	(−0·002)	175 28 43·56	+18·78	
5994	δ^2 Chamæleontis -	4·9	10 44 39·74	4	+ 0·645	− 0·030	169 55 5·26	+18·98	+ 0·01
6011	Lacaille 4578 -	(7·0)	10 46 58·43	9	− 3·365		176 16 40·81	+19·04	
6146	η Octantis - -	6·3	11 0 6·00	5	− 0·192	− 0·055	173 57 33·53	+19·37	+ 0·08
6387	Lacaille 4784 -	(7·0)	11 23 38·07	5	+ 0·955		174 18 20·70	+19·80	
6481	π^1 Chamæleontis -	6·2	11 32 24·42	5	+ 2·463	− 0·032	165 14 38·12	+19·91	+ 0·09
6513	Lacaille 4865 -	(7·0)	11 34 43·67	13	+ 1·446		174 50 0·58	+19·93	
6684	ϵ Chamæleontis -	5·0	11 53 47·13	6	+ 2·908	− 0·021	167 33 54·59	+20·05	+ 0·07
6703	Lacaille 4991 -	6·6	11 56 28·34	10	+ 2·839	− 0·043	174 58 29·10	+20·05	
6836	β Chamæleontis -	4·6	12 11 27·32	4	+ 3·405	− 0·017	168 39 25·21	+20·03	− 0·02
7017	Brisbane 4091 -	(7·0)	12 35 20·73	9	+16·926	− 0·088	179 9 4·96	+19·82	0·00
7073	ι Octantis - -	6·0	12 42 43·49	9	+ 5·636	+ 0·037	174 28 54·76	+19·71	0·00
7167	Lacaille 5325 -	(7·0)	12 54 43·57	11	+ 8·963	(−0·306)	176 55 29·81	+19·48	(+0·22)
7233	Lacaille 5406 -	6·3	13 4 31·12	5	+ 4·793	− 0·004	167 49 14·15	+19·26	+ 0·08
7387	κ Octantis - -	5·7	13 22 5·70	13	+ 8·631	− 0·052	175 10 47·61	+18·78	+ 0·05
7546	Lacaille 5633 -	6·6	13 40 42·41	12	+ 7·160		172 4 48·62	+18·15	

Stone 5351—Lac. 4169. A star, 7·5 magnitude, precedes 13ˢ·76 and is 0″·35 North.

Digitized by Google

No. in Stone.	Star's Name.	Magnitude.	Mean R.A. 1882·0.	No. of Obs.	Precess.	Proper Motion.	Mean N.P.D. 1882·0 (from Stone).	Precess.	Proper Motion.
			h m s		s	s	° ′ ″	″	″
7731	Brisbane 4614 -	(7·0)	14 2 7·90	14	+ 36·481		178 50 7·47	+17·27	
7780	δ Octantis - -	4·7	14 8 9·89	10	+ 8·955	− 0·053	173 7 31·00	+17·00	+ 0·02
7960	z Octantis - -	6·8	14 31 51·59	19	+ 23·230	− 0·160	177 39 48·40	+15·81	+ 0·05
8083	Brisbane 5046 -	5·9	14 44 23·10	5	+ 9·804	− 0·011	172 33 43·69	+15·11	
8363	ρ Octantis - -	5·9	15 16 17·60	10	+ 12·793	+ 0·091	174 4 3·13	+13·14	− 0·03
8601	Lacaille 6484 -	6·7	15 43 31·91	9	+ 8·139		167 40 33·33	+11·25	
8896	γ Apodis - -	3·9	16 15 23·79	5	+ 9·040	− 0·045	168 37 45·16	+ 8·84	+ 0·16
8914	Brisbane 5607 -	6·3	16 17 14·24	22	+ 20·914	0·000	176 8 11·60	+ 8·69	+ 0·04
8984	β Apodis - -	4·5	16 26 15·57	10	+ 8·501	− 0·105	167 16 1·52	+ 7·98	+ 0·34
9145	Lacaille 6948 -	6·8	16 44 42·27	6	+ 8·157		166 1 25·04	+ 6·47	
9273	* - - -	(7·0)	16 56 57·75	8	+ 30·065		177 16 15·28	+ 5·45	
9393	Lacaille 7088 -	6·4	17 9 25·47	6	+ 11·078	− 0·008	170 44 41·90	+ 4·39	+ 0·06
9538	Lacaille 7078 -	6·4	17 24 23·10	9	+ 18·673		175 9 39·14	+ 3·10	
9588	Lacaille 7184 -	(6·3)	17 29 41·04	5	+ 14·163		173 11 9·15	+ 2·65	
9725	Brisbane 6058 -	5·8	17 45 22·48	16	+ 35·715	− 0·112	177 39 33·69	+ 1·28	
9817	Lacaille 7348 -	6·5	17 55 14·17	9	+ 16·756		174 25 14·61	+ 0·42	
10085	σ Octantis - -	5·8	18 28 6·12	20	+107·729	+0·075	179 16 25·37	− 2·45	+ 0·02
10343	Lacaille 7751 -	(7·0)	18 55 10·39	15	+ 17·680		174 55 14·99	− 4·78	
10611	Lacaille 8094 -	6·9	19 34 12·16	7	+ 11·414	0·000	171 38 27·16	− 8·01	− 0·04
10885	Lacaille 8257 -	7·0	20 14 13·90	16	+ 15·322		174 48 11·84	−11·09	
10907	Lacaille 8360 -	6·5	20 18 15·05	5	+ 10·605		171 41 3·42	−11·38	
11135	α Octantis - -	5·6	20 50 22·18	9	+ 7·501	−0·001	167 28 18·50	−13·57	+ 0·40
11435	λ Octantis - -	5·7	21 32 39·94	13	+ 9·852	0·000	173 15 33·08	−16·05	0·00
11542	Lacaille 8927 -	6·6	21 49 29·15	5	+ 6·531		168 13 32·00	−16·89	
11665	C Octantis - -	6·4	22 8 38·44	19	+ 13·474	−0·035	176 33 55·73	−17·73	− 0·08
11807	Lacaille 9123 -	(7·0)	22 30 44·87	8	+ 8·211		174 21 27·02	−18·55	
12005	Lacaille 9332 -	6·3	22 58 43·20	5	+ 5·100	+0·034	170 7 1·04	−19·34	
12069	τ Octantis - -	6·0	23 9 42·68	15	+ 11·980	+0·036	178 7 45·81	−19·57	− 0·02
12124	Lacaille 9401 -	(7·0)	23 17 9·26	5	+ 6·975		176 21 28·32	−19·70	
12199	Lacaille 9464 -	(7·0)	23 27 47·51	13	+ 6·707		177 3 2·49	−19·86	
12260	Lacaille 9560 -	6·1	23 37 28·51	6	+ 3·776		169 26 47·42	−19·96	
12272	Lacaille 9563 -	(7·0)	23 39 42·85	5	+ 4·304		174 31 5·67	−19·97	

Digitized by Google

Digitized by Google

SECTION III.

PLACES

OF

28 NORTHERN CIRCUMPOLAR STARS

OBSERVED AT

ADEN,

WITH THE AUTHORITIES ON WHICH THE ADOPTED PLACES DEPEND.

Digitized by Google

SECTION III.

LIST OF STARS USED FOR DETERMINING AZIMUTHAL ERRORS AT ADEN.

No.	Star's Name.	Mag.	Mean R.A. 1881·0.	Approx. N.P.D. 1881·0.	Authority for Star's Place.
			h m s	° ′	
1	Bradley 6 - -	6·7	0 9 29·87	13 43	
2	Bradley 24 -	6	0 19 31·73	10 36	Greenwich Catalogues, 1864 and 1872.
3	Cephei - -	6·5	1 2 2·59	10 58	
4	α Ursæ Minoris -	2	1 15 7·97	1 20	
5	40 Cassiopeiæ -	6	1 29 1·89	17 34	
6	50 Cassiopeiæ -	4	1 53 17·93	18 9	
7	36 Hev. Casiopeiæ -	6·5	2 26 44·92	17 42	
8	Piazzi III–160 -	5·3	3 50 11·80	9 38	Greenwich Catalogues, 1864 and 1872.
9	51 Hev. Cephei -	5	6 44 16·56	2 46	
10	35 Draconis - -	5	17 54 46·67	13 1	
11	χ Draconis - -	4·3	18 23 12·06	17 19	
12	Groombr. 2784 -	6·7	19 2 55·87	13 9	Radcliffe Catalogue, 1845.
13	τ Draconis - -	5	19 17 50·04	16 52	
14	σ Draconis - -	5·3	19 32 35·19	20 32	Greenwich Catalogues, 1860, 1864, and 1872.
15	λ Ursæ Minoris -	6·3	19 43 7·69	1 3	
16	64 Draconis - -	5·7	20 0 1·74	25 31	Greenwich Catalogues, 1864 and 1872.
17	κ Cephei - -	4·5	20 12 52·22	12 39	
18	73 Draconis - -	5·6	20 33 3·75	15 27	
19	76 Draconis - -	6	20 51 6·75	7 55	
20	77 Draconis - -	6	21 7 51·18	12 21	
21	β Cephei - -	3	21 27 7·24	19 58	
22	11 Cephei - -	5	21 40 10·43	19 14	
23	24 Cephei - -	5·4	22 7 31·01	18 14	
24	Bradley 2993 -	5·3	22 22 35·81	4 30	Greenwich Catalogues, 1860, 1864, and 1872.
25	31 Cephei - -	5	22 32 49·79	16 58	
26	Bradley 3038 -	5	22 47 54·52	7 29	Greenwich Catalogue, 1872.
27	Bradley 3147 -	6	23 27 50·03	3 21	Greenwich Catalogues, 1864 and 1872.
28	γ Cephei - -	3·4	23 34 28·45	13 2	

In all cases where no authority is mentioned in the last column, the star's place has been taken from "*Mittlere und Scheinbare Oerter*, &c."

Digitized by Google

SECTION IV.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE.

	Page
TABLE 1.—Determination of Collimation Error - - - -	18
„ 2.— „ „ Level Error - - - - -	19
„ 3.— „ „ Azimuth Error - - - -	20
„ 4.—Transit Observations, Mr. Pett - - - -	24
„ 5.— „ „ Mr. Freeman - - - -	30

Digitized by Google

SECTION IV.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF CAPE TRANSIT CIRCLE.

Date.	Hour.	Reading for line of Collimation.	Collimation Error.	Observer.
1881.		rev.	s	
April 9	$6\frac{1}{2}$	30·168	+0·013	P.
	$6\frac{1}{2}$	30·190	−0·008	I.
April 14	$6\frac{3}{4}$	30·162	+0·019	P.
	$6\frac{1}{2}$	30·177	+0·005	I.
May 12	$6\frac{3}{4}$	30·162	+0·019	P.
	7	30·175	+0·007	I.
May 20	$6\frac{1}{4}$	30·151	+0·030	P.
May 23	$6\frac{1}{2}$	30·137	+0·043	P.
	$6\frac{1}{2}$	30·138	+0·042	I.
June 16	$6\frac{3}{4}$	30·170	+0·011	P.
	$6\frac{1}{2}$	30·167	+0·014	I.
June 17	$6\frac{1}{2}$	30·164	+0·017	P.
	$6\frac{1}{2}$	30·172	+0·010	I.
June 20	7	30·134	+0·046	P.
	$6\frac{1}{2}$	30·138	+0·042	I.
June 21	$6\frac{3}{4}$	30·153	+0·028	P.
	$6\frac{3}{4}$	30·158	+0·023	I.
June 22	$6\frac{1}{2}$	30·145	+0·035	P.
	$6\frac{1}{2}$	30·145	+0·035	I.
June 27	$6\frac{3}{4}$	30·148	+0·032	P.
	$6\frac{3}{4}$	30·139	+0·041	I.
Aug. 18	$5\frac{1}{4}$	30·151	+0·030	P.
	$8\frac{1}{2}$	30·165	+0·016	I.
Aug. 19	$5\frac{1}{4}$	30·162	+0·019	P.
	$8\frac{3}{4}$	30·144	+0·036	I.
Aug. 25	$5\frac{1}{2}$	30·145	+0·035	P.
	$8\frac{3}{4}$	30·147	+0·033	I.
Aug. 26	$5\frac{3}{4}$	30·155	+0·026	P.
	$8\frac{1}{2}$	30·147	+0·033	I.
Aug. 27	$5\frac{1}{2}$	30·153	+0·028	P.
	$8\frac{1}{2}$	30·149	+0·031	I.
1881.		rev.	s	
Aug. 28	$5\frac{1}{4}$	30·162	+0·019	P.
	$6\frac{1}{2}$	30·156	+0·025	I.
Sept. 3	$8\frac{1}{4}$	30·156	+0·025	P.
Sept. 19	$5\frac{1}{2}$	30·149	+0·031	P.
	$5\frac{1}{2}$	30·168	+0·013	I.
Dec. 23	7	30·173	+0·009	P.
	7	30·193	−0·011	I.
Dec. 29	$6\frac{3}{4}$	30·182	·000	P.
Dec. 30	$6\frac{3}{4}$	30·185	−0·003	P.
1882.			s	
Jan. 8	22	30·151	+0·030	P.
Jan. 9	$6\frac{1}{2}$	30·161	+0·020	I.
Jan. 14	$6\frac{1}{4}$	30·165	+0·016	P.
Jan. 17	$6\frac{1}{4}$	30·176	+0·006	P.
Jan. 20	6	30·193	−0·010	P.
Jan. 21	$6\frac{3}{4}$	30·186	−0·004	I.
Jan. 26	$6\frac{1}{2}$	30·196	−0·013	P.
Jan. 27	9	30·180	+0·002	P.
Jan. 28	$6\frac{3}{4}$	30·184	−0·002	P.
Feb. 13	$6\frac{3}{4}$	30·187	−0·005	P.
Feb. 14	$6\frac{1}{4}$	30·194	−0·011	P.
	$6\frac{1}{2}$	30·192	−0·010	I.
Feb. 15	$6\frac{3}{4}$	30·181	+0·001	P.
	$6\frac{3}{4}$	30·179	+0·003	I.
Feb. 17	$6\frac{3}{4}$	30·171	+0·010	P.
	7	30·193	−0·010	I.

Digitized by Google

SECTION IV.—TABLE 2.

DETERMINATIONS OF LEVEL ERROR OF THE TRANSIT CIRCLE.

Date.	Hour.	Level Error. Observed.	Level Error. Adopted.	Observer.
1881.		s	s	
April 9	$7\frac{1}{4}$	−1·023	−1·028	P.
	$11\frac{3}{4}$	−1·033		
	$7\frac{1}{4}$	−1·050	−1·050	I.
April 13	$7\frac{1}{4}$	−1·049	−1·049	P.
	7	−1·061	−1·061	I.
April 14	7	−1·058	−1·060	P.
	$11\frac{1}{2}$	−1·063		
	7	−1·089	−1·089	I.
May 12	7	−1·081	−1·069	P.
	$11\frac{1}{2}$	−1·057		
	7	−1·081	−1·081	I.
May 20	$6\frac{1}{2}$	−1·036	−1·036	P.
May 23	7	−1·047	−1·050	P.
	$11\frac{3}{4}$	−1·052		
	7	−1·055	−1·055	I.
June 16	$6\frac{1}{2}$	−1·183	−1·181	P.
	$8\frac{3}{4}$	−1·187		
	$13\frac{1}{2}$	−1·174		
	$6\frac{1}{2}$	−1·188	−1·178	I.
	$13\frac{1}{2}$	−1·167		
June 17	$6\frac{1}{2}$	−1·162	−1·153	P.
	$8\frac{3}{4}$	−1·153		
	$13\frac{1}{4}$	−1·145		
	$6\frac{1}{2}$	−1·171	−1·164	I.
	$13\frac{1}{4}$	−1·156		
June 20	$6\frac{1}{2}$	−1·057	−1·052	P.
	9	−1·052		
	$12\frac{1}{2}$	−1·048		
	$6\frac{1}{2}$	−1·068	−1·057	I.
	9	−1·058		
	$12\frac{1}{2}$	−1·046		
June 21	$6\frac{1}{2}$	−1·063	−1·062	P.
	$8\frac{3}{4}$	−1·066		
	$14\frac{3}{4}$	−1·057		
	$6\frac{1}{2}$	−1·065	−1·068	I.
	$8\frac{3}{4}$	−1·080		
	$14\frac{3}{4}$	−1·059		
June 22	6	−1·052	−1·044	P.
	$8\frac{3}{4}$	−1·040		
	$12\frac{1}{4}$	−1·041		
	$6\frac{1}{2}$	−1·046	−1·050	I.
	$8\frac{3}{4}$	−1·054		
	$12\frac{1}{2}$	−1·049		
June 27	$6\frac{1}{4}$	−1·135	−1·109	P.
	9	−1·083	−1·083	
	$12\frac{3}{4}$	−1·082		
	$6\frac{1}{2}$	−1·125	−1·110	I.
	9	−1·095	−1·086	
	$12\frac{3}{4}$	−1·077		
1881.				
Aug. 18	$5\frac{1}{2}$	+0·206		
	$8\frac{1}{4}$	+0·211	+0·214	P.
	12	+0·225		
	$8\frac{1}{4}$	+0·192	+0·191	I.
	$10\frac{1}{4}$	+0·189		
Aug. 19	$5\frac{1}{2}$	+0·225		
	$8\frac{1}{2}$	+0·237	+0·234	P.
	11	+0·240		
	$8\frac{1}{2}$	+0·258	+0·250	I.
	11	+0·242		
Aug. 25	$8\frac{1}{2}$	+0·397	+0·400	P.
	10	+0·402		
	$8\frac{1}{2}$	+0·386	+0·388	I.
	$9\frac{3}{4}$	+0·389		
Aug. 26	$8\frac{1}{2}$	+0·380	+0·372	P.
	12	+0·364		
	$8\frac{3}{4}$	+0·367	+0·367	I.
	$9\frac{1}{2}$	+0·367		
Aug. 27	$8\frac{1}{4}$	+0·344	+0·343	P.
	$11\frac{1}{4}$	+0·341		
	$8\frac{1}{2}$	+0·348	+0·340	I.
	$9\frac{1}{2}$	+0·333		
Aug. 28	$6\frac{1}{2}$	+0·309	+0·318	P.
	$11\frac{1}{4}$	+0·326		
	$6\frac{1}{2}$	+0·305	+0·317	I.
	$11\frac{1}{4}$	+0·328		
Sept. 3	$7\frac{1}{4}$	+0·419	+0·421	P.
	$10\frac{1}{4}$	+0·422		
Sept. 19	$6\frac{1}{4}$	+0·530		
	$8\frac{1}{2}$	+0·528	+0·533	P.
	$10\frac{3}{4}$	+0·541		
	$6\frac{1}{4}$	+0·506		
	$8\frac{1}{2}$	+0·504	+0·504	I.
	$10\frac{1}{4}$	+0·502		
Dec. 23	$7\frac{1}{4}$	+0·286		
	$10\frac{1}{4}$	+0·290	+0·289	P.
	$13\frac{3}{4}$	+0·292		
	$7\frac{1}{4}$	+0·257		
	$9\frac{3}{4}$	+0·262	+0·261	I.
	$13\frac{3}{4}$	+0·264		
Dec. 29	$7\frac{1}{2}$	+0·236	+0·236	P.
	$7\frac{1}{2}$	+0·224	+0·224	I.
Dec. 30	$7\frac{1}{2}$	+0·245	+0·242	P.
	$12\frac{1}{4}$	+0·238		

Digitized by Google

Date.	Hour.	Level Error. Observed.	Level Error. Adopted.	Observer.
1882.		s	s	
Jan. 8	9	+0·162	+0·162	P.
Jan. 9	7	+0·127	+0·127	P.
	7	+0·108	+0·108	I.
Jan. 14	6	+0·026	+0·026	P.
Jan. 17	6½	−0·016	−0·015	P.
	11⅓	−0·013		
Jan. 20	6½	−0·028	−0·031	P.
	12	−0·033		
Jan. 21	9¼	−0·030	−0·030	P.
	7	−0·059	−0·051	I.
	9½	−0·043		
Jan. 26	7	−0·072	−0·066	P.
	10¾	−0·060		
Jan. 27	6½	−0·052	−0·044	P.
	11	−0·036		
1882.				
Jan. 28	7	−0·054	−0·054	P.
Feb. 13	6¾	−0·246	−0·242	P.
	11¾	−0·239		
	7	−0·249	−0·247	I.
	11¼	−0·244		
Feb. 14	6	−0·249	−0·254	P.
	11¼	−0·259		
	7	−0·244	−0·257	I.
	11	−0·269		
Feb. 15	6½	−0·240	−0·245	P.
	11¼	−0·250		
	6½	−0·252	−0·254	I.
	11	−0·256		
Feb. 17	7	−0·255	−0·258	P.
	11	−0·262		
	7	−0·297	−0·293	I.
	11	−0·288		

SECTION IV.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF CAPE TRANSIT CIRCLE.

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
Apr. 9	P.	Lacaille 8798 S.P.	9 33 56·31	9 32 29·95	+0·374	+0·400
		Lacaille 4169	9 49 18·42	9 47 45·22	+0·401	
		Lacaille 248 S.P.	12 40 51·74	12 39 27·22	+0·354	
		ι Octantis	12 44 27·35	12 42 54·16	+0·473	
	I.	Lacaille 9123 S.P.	10 31 58·18	10 30 31·75	+0·269	+0·328
		Lacaille 4578	10 48 49·33	10 47 16·30	+0·334	
		Lacaille 9464 S.P.	11 28 45·83	11 27 22·44	+0·321	
		Lacaille 4865	11 36 28·39	11 34 56·03	+0·389	
Apr. 13	I.					+0·406
Apr. 14	P.	Lacaille 8798 S.P.	9 34 0·88	9 32 30·84	+0·437	+0·415
		Lacaille 4169	9 49 22·76	9 47 44·06	+0·528	
		Lacaille 248 S.P.	12 40 56·80	12 39 27·45	+0·303	
		ι Octantis	12 44 30·87	12 42 54·08	+0·391	
	I.	Lacaille 9123 S.P.	10 32 2·44	10 30 32·57	+0·378	+0·446
		Lacaille 4578	10 48 53·52	10 47 15·26	+0·418	
		Lacaille 9464 S.P.	11 28 49·95	11 27 23·46	+0·397	
		Lacaille 4865	11 36 34·01	11 34 55·54	+0·589	
May 12	P.	Lacaille 9464 S.P.	11 28 20·48	11 27 31·41	+0·514	+0·477
		Lacaille 4865	11 35 53·41	11 34 51·53	+0·490	
		ι Octantis	14 33 23·57	14 32 17·45	+0·428	
	I.	Lacaille 248 S.P.	12 40 24·66	12 39 30·97	+0·260	+0·405
		ι Octantis	12 43 54·37	12 42 52·20	+0·591	
		Lacaille 5452	13 18 24·02	13 17 22·35	+0·454	
		Lacaille 634 S.P.	13 45 0·66	13 44 6·71	+0·317	

Digitized by Google

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
May 20	P.	Lacaille 9464 S.P.	11 28 31·87	11 27 34·26	+0·472	
		Lacaille 4865	11 36 0·18	11 34 50·06	+0·540	+0·490
		Lacaille 248 S.P.	12 40 32·70	12 39 32·62	+0·403	
		ι Octantis	12 44 1·25	12 42 51·24	+0·546	
May 23	P.	Lacaille 248 S.P.	12 40 36·96	12 39 33·30	+0·373	
		Lacaille 5325	12 56 14·49	12 54 58·95	+0·454	+0·392
		Lacaille 634 S.P.	13 45 13·61	13 44 8·85	+0·287	
		Brisbane 4614	14 4 24·74	14 2 57·80	+0·452	
	I.	Lacaille 4991	11 57 48·05	11 56 35·77	+0·439	
		Lacaille 9745 S.P.	12 3 15·10	12 2 12·33	+0·376	+0·466
		z Octantis	14 33 36·04	14 32 16·85	+0·535	
		Lacaille 1029 S.P.	14 39 8·68	14 38 6·95	+0·515	
June 16	P.	Lacaille 248 S.P.	12 40 7·33	12 39 39·82	+0·336	
		κ Octantis	13 22 47·89	13 22 13·24	+0·280	+0·327
		Brisbane 6058	17 46 28·21	17 45 49·57	+0·322	
		Lacaille 8094	19 34 51·79	19 34 17·62	+0·368	
	I.	Lacaille 634 S.P.	13 44 40·49	13 44 11·63	+0·274	
		Brisbane 6058	17 46 28·32	17 45 49·57	+0·338	+0·282
		Lacaille 3274 S.P.	19 28 5·04	19 27 36·69	+0·235	
June 17	P.	ι Octantis	12 43 23·05	12 42 46·82	+0·405	+0·397
		σ Octantis	18 30 27·55	18 29 29·13	+0·389	
	I.	κ Octantis	13 22 48·37	13 22 13·05	+0·283	
		Lacaille 634 S.P.	13 44 41·59	13 44 11·83	+0·271	+0·309
		Brisbane 6058	17 46 29·96	17 45 49·70	+0·372	
June 20	P.	κ Octantis	13 22 50·76	13 22 12·48	+0·294	
		Lacaille 634 S.P.	13 44 43·79	13 44 12·45	+0·400	+0·365
		Brisbane 6058	17 46 32·85	17 45 50·03	+0·361	
		Lacaille 2296 S.P.	17 53 23·40	17 52 51·61	+0·406	
	I.	z Octantis	14 32 56·36	14 32 11·09	+0·490	
		Lacaille 1921 S.P.	17 12 44·65	17 12 11·98	+0·416	+0·448
		Lacaille 7078	17 25 15·71	17 24 36·05	+0·437	
June 21	P.	κ Octantis	13 22 51·28	13 22 12·29	+0·280	
		Lacaille 634 S.P.	13 44 45·23	13 44 12·66	+0·356	+0·340
		A Octantis S.P.	20 5 41·14	20 5 17·20	+0·384	
		Lacaille 8257	20 15 1·83	20 14 22·41	+0·341	
	I.	z Octantis	14 32 55·06	14 32 10·78	+0·403	
		Lacaille 1029 S.P.	14 38 43·10	14 38 10·98	+0·313	+0·390
		Lacaille 3274 S.P.	19 28 5·96	19 27 35·61	+0·379	
		Lacaille 8360	20 18 58·86	20 18 20·09	+0·465	
June 22	P.	κ Octantis	13 22 52·25	13 22 12·09	+0·317	
		Lacaille 634 S.P.	13 44 46·08	13 44 12·87	+0·374	+0·355
		Brisbane 6058	17 46 33·15	17 45 50·20	+0·287	
		Lacaille 2296 S.P.	17 53 24·65	17 52 51·55	+0·440	
	I.	z Octantis	14 32 57·87	14 32 10·46	+0·524	
		Lacaille 1029 S.P.	14 38 44·20	14 38 11·19	+0·297	+0·429
		Lacaille 1921 S.P.	17 12 46·31	17 12 12·00	+0·404	
		Lacaille 7078	17 25 17·80	17 24 36·10	+0·491	
June 27	P.	Lacaille 634 S.P.	13 44 53·00	13 44 13·97	+0·309	+0·294
		Lacaille 5802	14 8 58·78	14 8 14·71	+0·278	
	I.	z Octantis	14 32 57·83	14 32 8·80	+0·346	+0·346

Digitized by Google

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
Aug. 18	P.	Brisbane 5607	16 18 1·00	16 17 18·51	+0·859	
		Lacaille 1839 S.P.	16 34 31·69	16 34 11·39	+0·853	+0·874
		Lacaille 4169 S.P.	21 47 40·37	21 47 18·26	+0·955	
		C Octantis	22 9 41·32	22 8 57·80	+0·827	
	I.	Brisbane 6058	17 46 28·76	17 45 40·17	+0·828	
		Lacaille 2296 S.P.	17 53 21·59	17 52 56·50	+0·731	+0·825
		Lacaille 8257	20 15 6·26	20 14 25·92	+0·915	
Aug. 19	P.	Brisbane 5607	16 18 1·86	16 17 18·22	+0·876	
		Lacaille 1839 S.P.	16 34 32·02	16 34 11·71	+0·917	+0·912
		Lacaille 4169 S.P.	21 47 40·89	21 47 18·25	+0·987	
		C Octantis	22 9 42·84	22 8 57·85	+0·867	
	I.	Brisbane 6058	17 46 30·78	17 45 39·76	+0·902	
		Lacaille 2296 S.P.	17 53 22·13	17 52 56·69	+0·803	+0·903
		ζ Octantis S.P.	21 13 43·60	21 13 20·00	+0·957	
		C Octantis	22 9 43·70	22 8 57·85	+0·949	
Aug. 25	P.	Brisbane 5607	16 18 6·32	16 17 16·49	+0·932	
		Lacaille 1839 S.P.	16 34 39·87	16 34 13·70	+0·900	+0·909
		ζ Octantis S.P.	21 13 49·41	21 13 20·25	+0·959	
		C Octantis	22 9 48·45	22 8 58·09	+0·843	
	I.	Lacaille 2296 S.P.	17 53 29·49	17 52 57·87	+0·721	
		σ Octantis	18 30 43·03	18 29 5·14	+0·905	+0·768
		ζ Octantis S.P.	21 13 51·15	21 13 20·25	+0·764	
		B Octantis	21 18 8·61	21 16 36·67	+0·680	
Aug. 26	P.	Brisbane 5607	16 18 6·22	16 17 16·19	+0·871	
		Lacaille 1839 S.P.	16 34 41·35	16 34 14·04	+0·880	+0·870
		Lacaille 4169 S.P.	21 47 48·10	21 47 18·31	+0·933	
		C Octantis	22 9 48·76	22 8 58·10	+0·796	
	I.	Lacaille 2296 S.P.	17 53 30·13	17 52 58·08	+0·781	
		σ Octantis	18 30 42·91	18 29 3·71	+0·913	+0·883
		Lacaille 8257	20 15 14·05	20 14 25·29	+1·043	
		ζ Octantis S.P.	21 13 51·65	21 13 20·31	+0·796	
Aug. 27	P.	Brisbane 5607	16 18 6·83	16 17 15·90	+0·856	
		Lacaille 1839 S.P.	16 34 42·29	16 34 14·38	+0·916	+0·879
		ζ Octantis S.P.	21 13 52·04	21 13 20·37	+0·912	
		C Octantis	22 9 50·14	22 8 58·11	+0·832	
	I.	Lacaille 2296 S.P.	17 53 31·45	17 52 58·29	+0·778	
		σ Octantis	18 30 46·28	18 29 2·23	+0·970	+0·886
		Lacaille 8257	20 15 14·42	20 14 25·18	+0·970	
		ζ Octantis S.P.	21 13 52·66	21 13 20·37	+0·827	
Aug. 28	P.	Brisbane 5607	16 18 7·36	16 17 15·60	+0·831	
		Lacaille 1839 S.P.	16 34 43·82	16 34 14·38	+0·886	+0·824
		ζ Octantis S.P.	21 13 54·43	21 13 20·44	+0·798	
		C Octantis	22 9 50·79	22 8 58·11	+0·782	
	I.	Brisbane 6058	17 46 36·75	17 45 35·91	+0·956	
		Lacaille 2296 S.P.	17 53 33·40	17 52 58·50	+0·721	+0·869
		σ Octantis	18 30 46·28	18 29 0·73	+0·973	
		ζ Octantis S.P.	21 13 53·88	21 13 20·44	+0·825	
Sept. 3	P.	Brisbane 6058	17 46 37·04	17 45 33·13	+0·820	
		Lacaille 2296 S.P.	17 53 39·40	17 52 59·79	+0·847	+0·933
		C Octantis	22 9 59·92	22 8 57·98	+1·045	
		Lacaille 4510 S.P.	22 38 10·89	22 37 34·15	+1·027	
Sept. 19	P.	Lacaille 7751	18 56 26·82	18 55 15·05	+0·916	
		A Octantis S.P.	20 5 56·07	20 5 24·05	+0·973	+0·912
		τ Octantis	23 11 42·59	23 10 17·44	+0·859	
		Lacaille 4991 S.P.	23 57 11·08	23 56 16·24	+0·900	

Digitized by Google

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1881.			h m s	h m s	s	s
Sept. 19	I.	Lacaille 3274 S.P.	19 28 35·33	19 27 44·04	+0·777	
		Lacaille 8257	20 15 34·30	20 14 21·88	+1·042	+0·866
		Lacaille 4169 S.P.	21 48 15·00	21 47 20·34	+0·794	
		C Octantis	22 10 11·15	22 8 56·46	+0·850	
Dec. 23	P.	Lacaille 634	1 45 15·86	1 44 23·61	+1·172	
		z Octantis S.P.	2 31 59·44	2 31 44·24	+1·230	+1·161
		Lacaille 3274	7 29 12·00	7 28 12·95	+1·275	
		Lacaille 8257 S.P.	8 14 34·53	8 14 3·44	+0·968	
	I.	z Octantis S.P.	2 32 6·35	2 31 44·24	+0·873	
		Lacaille 1029	2 39 25·32	2 38 30·76	+1·162	+1·036
		Lacaille 7751 S.P.	6 55 30·52	6 54 59·90	+0·964	
		Lacaille 3274	7 29 9·79	7 28 12·95	+1·143	
Dec. 29	P.	z Octantis S.P.	2 32 2·02	2 31 47·52	+1·130	+1·098
		Lacaille 1029	2 39 19·77	2 38 28·84	+1·066	
	I	Lacaille 1848	3 16 41·40	3 15 23·50	+1·164	+1·115
		Brisbane 5607 S.P.	4 17 29·97	4 17 5·87	+1·065	
1882.						
Jan. 8	P.	Brisbane 6058 S.P.	5 45 15·45	5 45 5·56	+1·155	+1·103
		Lacaille 2296	5 53 57·46	5 53 14·49	+1·051	
Jan. 9	P.	Lacaille 1592	4 5 21·27	4 4 37·18	+1·034	+1·064
		Brisbane 5607 S.P.	4 17 28·45	4 17 9·01	+1·093	
Jan. 14	P.	Lacaille 1414	3 46 15·55	3 45 33·48	+1·127	+1·127
Jan. 17	P.	Lacaille 1592	4 5 15·71	4 4 34·98	+0·982	+0·964
		Brisbane 5607	4 17 30·03	4 17 11·61	+0·946	
Jan. 20	P.	Brisbane 6058 S.P.	5 45 19·94	5 45 10·24	+0·967	+0·925
		Lacaille 2296	5 53 49·92	5 53 12·62	+0·882	
Jan. 21	P.	Lacaille 1592	4 5 12·23	4 4 33·81	+0·888	
		Brisbane 5607 S.P.	4 17 31·30	4 17 15·58	+1·069	+0·913
		Lacaille 7751 S.P.	6 55 22·97	6 55 2·12	+0·855	
		Lacaille 3274	7 28 53·26	7 28 11·77	+0·840	
Jan. 26	P.	Brisbane 5607 S.P.	4 17 32·10	4 17 14·76	+0·801	+0·797
		Lacaille 2296	5 53 45·93	5 53 11·48	+0·792	
Jan. 27	P.	Brisbane 5607 S.P.	4 17 31·20	4 17 15·13	+0·885	+0·866
		Lacaille 2296	5 53 46·07	5 53 11·28	+0·846	
Jan. 28	P.	Lacaille 1592	4 5 7·02	4 4 31·69	+0·792	
		Brisbane 5607 S.P.	4 17 31·78	4 17 15·49	+0·845	+0·836
		Brisbane 6058 S.P.	5 45 23·04	5 45 13·99	+0·870	
		Lacaille 2296	5 53 45·45	5 53 11·07	+0·837	
Feb. 13	P.	Brisbane 6058 S.P.	5 45 28·12	5 45 22·64	+0·792	
		Lacaille 2296	5 53 35·83	5 53 7·41	+0·750	+0·713
		A Octantis	8 7 6·26	8 6 23·38	+0·663	
		Lacaille 8257 S.P.	8 14 20·98	8 14 5·41	+0·647	
	I.	σ Octantis S.P.	6 27 19·17	6 27 42·22	+0·684	
		ζ Mensæ	6 50 19·89	6 49 54·90	+0·731	+0·710
		Lacaille 3274	7 28 39·44	7 28 6·61	+0·772	
		Lacaille 8094 S.P.	7 34 26·45	7 34 8·93	+0·653	
Feb. 14	P.	Brisbane 6058 S.P.	5 45 28·04	5 45 23·22	+0·807	
		Lacaille 2296	5 53 34·78	5 53 7·16	+0·703	+0·709
		A Octantis	8 7 5·87	8 6 22·77	+0·683	
		Lacaille 8257 S.P.	8 14 20·72	8 14 5·55	+0·643	

Digitized by Google

Date.	Observer.	Name of Star.	Time of Transit corrected for Collimation and Level.	Star's Apparent R.A.	Deduced Azimuth Error.	Adopted Azimuth Error.
1882.			h m s	h m s	s	s
Feb. 14	I.	σ Octantis S.P.	6 27 19·82	6 27 44·10	+0·694	
		ζ Mensæ	6 50 19·44	6 49 54·78	+0·733	+0·743
		Lacaille 3274	7 28 39·09	7 28 6·31	+0·787	
		Lacaille 8094 S.P.	7 34 26·22	7 34 9·05	+0·756	
Feb. 15	P.	σ Octantis S.P.	6 27 24·87	6 27 45·99	+0·643	
		ζ Mensæ	6 50 18·91	6 49 54·66	+0·696	+0·680
		Lacaille 3274	7 28 36·84	7 28 6·01	+0·671	
		Lacaille 8094 S.P.	7 34 25·95	7 34 9·18	+0·709	
	I.	Brisbane 6058 S.P.	5 45 30·08	5 45 23·81	+0·708	
		Lacaille 2296	5 53 35·19	5 53 6·90	+0·832	+0·777
		A Octantis	8 7 10·41	8 6 22·13	+0·859	
		Lacaille 8257 S.P.	8 14 19·76	8 14 5·70	+0·708	
Feb. 17	P.	σ Octantis S.P.	6 27 21·38	6 27 49·61	+0·742	
		ζ Mensæ	6 50 17·79	6 49 54·43	+0·671	+0·727
		Lacaille 3274	7 28 36·28	7 28 5·39	+0·728	
		Lacaille 8094 S.P.	7 34 25·06	7 34 9·42	+0·768	

The above Azimuthal Errors have been deduced from each Polar Star in combination with the Clock Star; the observations of the Clock Star are not given in this table.

SECTION IV.—TABLE 4.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE BY MR. PETT.

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	m s
April 9	Lalande 19241	9 43 50·42	6	49·69	20·48	−1 29·21
	13 Sextantis	9 59 30·95	6	30·38	1·16	−1 29·22
	λ Hydræ	10 6 19·77	6	18·96	49·80	−1 29·16
	21 Sextantis	10 9 45·24	6	44·50	15·21	−1 29·29
	22 Sextantis	10 13 15·64	6	14·90	45·70	−1 29·20
	η Virginis	12 15 22·00	6	21·38	52·09	−1 29·29
	6 Corvi	12 18 43·16	6	42·13	12·80	−1 29·33
	B.A.C. 4200	12 23 18·32	6	17·64	48·29	−1 29·35
	Piazzi XII–111	12 27 4·72	6	4·03	34·67	−1 29·36
April 14	Lalande 19241	9 43 54·57	6	53·83	20·42	−1 33·41
	13 Sextantis	9 59 35·07	6	34·50	1·10	−1 33·40
	λ Hydræ	10 6 23·94	6	33·12	49·74	−1 33·38
	21 Sextantis	10 9 49·49	6	48·74	15·16	−1 33·58
	22 Sextantis	10 13 19·94	6	19·19	45·65	−1 33·54
	6 Corvi	12 18 47·39	6	46·36	12·80	−1 33·56
	B.A.C. 4200	12 23 22·64	6	21·95	48·29	−1 33·66
	Piazzi XII–111	12 27 8·97	6	8·28	34·67	−1 33·61
May 12	A^1 Virginis	11 42 48·86	6	48·42	50·81	−0 57·61
	η Crateris	11 50 58·38	6	57·49	59·94	−0 57·55
	Lalande 22585	11 55 39·13	6	38·36	40·88	−0 57·48
	B.A.C. 4077	12 0 55·32	6	54·63	57·07	−0 57·56
	λ Virginis	14 13 42·24	6	41·42	43·73	−0 57·69
	B.A.C. 4773	14 19 17·45	6	16·96	19·29	−0 57·67
	φ Virginis	14 23 5·95	6	5·32	7·65	−0 57·67

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	m s
May 20	A^1 Virginis	11 42 56·66	6	56·26	50·73	−1 5·53
	η Crateris	11 51 6·14	6	5·29	59·87	−1 5·42
	Lalande 22585	11 55 47·01	6	46·28	40·81	−1 5·47
	B.A.C. 4077	12 1 3·02	6	2·43	57·00	−1 5·43
	44 Virginis	12 54 40·90	6	40·29	34·80	−1 5·49
	Lalande 24277	12 58 33·51	6	32·60	27·02	−1 5·58
	θ Virginis	13 4 56·62	6	55·98	50·45	−1 5·53
May 23	B.A.C. 4382	13 1 23·01	6	22·17	13·46	−1 8·71
	θ Virginis	13 4 59·87	6	59·18	50·44	−1 8·74
	54 Virginis	13 8 18·11	6	17·22	8·49	−1 8·73
	86 Virginis	13 40 48·84	4	48·04	39·23	−1 8·81
	τ Virginis	13 56 47·97	6	47·39	38·69	−1 8·70
	ι Virginis	14 10 59·30	6	58·60	49·88	−1 8·72
June 16	44 Virginis	12 54 7·54	6	6·70	34·60	−0 32·10
	Lalande 24277	12 58 0·06	6	58·93	26·81	−0 32·12
	B.A.C. 4382	13 0 46·38	6	45·35	13·29	−0 32·06
	θ Virginis	13 4 23·04	6	22·17	50·27	−0 31·90
	7 Sagittarii	17 56 11·46	6	10·26	37·95	−0 32·31
	μ^1 Sagittarii	18 7 16·51	6	15·36	43·06	−0 32·30
	21 Sagittarii	18 18 53·59	6	52·45	20·02	−0 32·43
	B.A.C. 6279	18 23 2·33	6	1·30	28·98	−0 32·32
June 17	44 Virginis	12 54 8·37	6	7·60	34·59	−0 33·01
	Lalande 24277	12 58 0·83	6	59·76	26·80	−0 32·96
	B.A.C. 4382	13 0 47·21	6	46·25	13·28	−0 32·97
	θ Virginis	13 4 23·94	4	23·14	50·26	−0 32·88
	μ^1 Sagittarii	18 7 17·36	6	16·28	43·08	−0 33·20
	Rumker 6386	18 14 1·84	6	1·25	27·98	−0 33·27
	21 Sagittarii	18 18 54·29	6	53·21	20·03	−0 33·18
	B.A.C. 6279	18 23 3·09	6	2·13	28·99	−0 33·14
June 20	66 Virginis	13 19 0·92	6	0·23	24·53	−0 35·70
	m Virginis	13 36 1·64	6	0·89	25·16	−0 35·73
	86 Virginis	13 40 15·53	6	14·72	39·09	−0 35·63
	47 Hydræ	13 52 30·74	6	29·72	54·09	−0 35·63
	μ^1 Sagittarii	18 7 19·78	6	18·82	43·12	−0 35·70
	Lalande 33596	18 10 46·60	6	46·02	10·20	−0 35·82
	Rumker 6386	18 14 4·19	6	3·68	28·01	−0 35·67
	21 Sagittarii	18 18 56·81	6	55·85	20·08	−0 35·77
June 21	66 Virginis	13 19 1·70	6	0·97	24·52	−0 36·45
	86 Virginis	13 39 16·28	6	15·43	39·08	−0 36·35
	p Virginis	13 49 15·70	6	15·03	38·62	−0 36·41
	47 Hydræ	13 52 31·53	6	30·47	54·08	−0 36·39
	63 Sagittarii	19 55 59·90	6	59·02	22·50	−0 36·52
	ρ Capricorni	20 22 45·74	6	44·80	8·19	−0 36·61
	Washington 8892	20 25 5·52	6	4·62	28·04	−0 36·58
	ϵ Delphini	20 28 12·14	6	11·64	35·10	−0 36·54
June 22	66 Virginis	13 19 2·32	6	1·62	24·52	−0 37·10
	m Virginis	13 36 2·94	6	2·19	25·14	−0 37·05
	86 Virginis	13 40 17·01	6	16·20	39·07	−0 37·13
	47 Hydræ	13 52 32·29	6	31·27	54·07	−0 37·20
	μ^1 Sagittarii	18 7 21·51	6	20·55	43·14	−0 37·41
	Lalande 33596	18 10 48·24	6	47·65	10·22	−0 37·43
	Rumker 6386	18 14 5·89	6	5·38	28·04	−0 37·34
	21 Sagittarii	18 18 58·46	6	57·50	20·11	−0 37·39

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
June 27	86 Virginis	13 40 22·28	6	21·37	39·03	− 42·34
	47 Hydræ	13 52 37·48	6	36·37	54·03	− 42·34
	96 Virginis	14 3 26·61	6	25·74	43·47	− 42·27
	B.A.C. 4773	14 19 2·05	6	1·42	19·16	− 42·26
	B.A.C. 6324	18 29 13·13	6	12·26	29·68	− 42·58
	B.A.C. 6347	18 32 35·66	6	34·62	52·05	− 42·57
	B.A.C. 6367	18 37 49·84	6	49·01	6·52	− 42·49
	B.A.C. 6388	18 41 38·95	6	38·17	55·66	− 42·51
Aug. 18	σ^2 Scorpii	16 5 34·41	6	34·79	2·35	− 32·44
	χ Ophiuchi	16 20 43·28	6	43·78	11·39	− 32·39
	12 Ophiuchi	16 30 41·65	6	42·32	9·81	− 32·51
	23 Ophiuchi	16 48 49·49	6	50·13	17·66	− 32·47
	ζ Capricorni	21 20 29·19	6	29·63	57·05	− 32·58
	Lalande 41765	21 23 55·54	6	56·01	23·43	− 32·58
	8 Piscis Australis	21 29 53·79	6	54·18	21·64	− 32·54
	ζ Aquarii	21 32 1·42	6	2·02	29·41	− 32·61
Aug. 19	28 Herculis	16 27 20·09	6	20·88	47·52	− 33·36
	12 Ophiuchi	16 30 42·49	6	43·19	9·80	− 33·39
	23 Ophiuchi	16 48 50·40	6	51·06	17·65	− 33·41
	Lalande 30831	16 52 32·14	6	32·70	59·31	− 33·39
	B.A.C. 7649	21 52 43·16	6	43·64	10·11	− 33·53
	B.A.C. 7665	21 56 16·29	6	16·81	43·32	− 33·49
	υ Aquarii	22 28 48·56	6	49·03	15·47	− 33·56
Aug. 25	12 Ophiuchi	16 30 47·84	6	48·72	9·71	− 39·01
	23 Ophiuchi	16 48 55·65	6	56·48	17·56	− 38·92
	Lalande 31109	17 1 24·24	6	25·02	46·04	− 38·98
	Lalande 31210	17 4 45·13	6	45·90	6·96	− 38·94
	11 Aquarii	20 55 0·44	6	1·28	22·19	− 39·09
	η Capricorni	20 58 20·91	6	21·59	42·55	− 39·04
	ν Aquarii	21 3 49·43	6	50·21	11·12	− 39·09
Aug. 26	14 Ophiuchi	16 36 23·00	4	23·84	44·14	− 39·70
	20 Ophiuchi	16 43 57·68	6	58·42	18·60	− 39·82
	23 Ophiuchi	16 48 56·52	6	57·29	17·54	− 39·75
	30 Ophiuchi	16 55 29·57	6	30·36	50·54	− 39·82
	Lalande 31210	17 4 46·04	6	46·75	6·95	− 39·80
	ξ Aquarii	21 32 8·76	6	9·51	29·44	− 40·07
	41 Capricorni	21 35 58·13	6	58·73	18·81	− 39·92
	27 Aquarii	21 41 55·35	6	56·20	16·26	− 39·94
	B.A.C. 7649	21 52 49·49	6	50·11	10·15	− 39·96
Aug. 27	Lalande 30831	16 52 39·46	6	40·12	59·18	− 40·94
	30 Ophiuchi	16 55 30·65	6	31·42	50·53	− 40·89
	37 Ophiuchi	17 7 34·43	6	35·34	54·39	− 40·95
	41 Ophiuchi	17 11 13·67	6	14·48	33·58	− 40·90
	Lalande 41765	21 24 3·91	6	4·52	23·45	− 41·07
	8 Piscis Australis	21 30 2·24	6	2·78	21·67	− 41·11
	ξ Aquarii	21 32 9·89	6	10·62	29·44	− 41·18
	41 Capricorni	21 35 59·34	6	59·91	18·81	− 41·10
Aug. 28	σ^2 Scorpii	16 5 43·78	6	44·26	2·18	− 42·08
	25 Scorpii	16 40 19·74	6	20·25	38·11	− 42·14
	20 Ophiuchi	16 44 0·06	6	0·72	18·56	− 42·16
	Lalande 30831	16 52 40·66	6	41·27	59·17	− 42·10
	ζ Capricorni	21 20 38·86	6	39·38	57·07	− 42·31
	8 Piscis Australis	21 30 3·51	6	4·00	21·67	− 42·33
	ξ Aquarii	21 32 11·08	6	11·71	29·44	− 42·27
	41 Capricorni	21 36 0·63	6	1·15	18·81	− 42·34

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
Sept. 3	μ Ophiuchi	17 32 13·26	6	14·08	26·23	− 47·85
	o Serpentis	17 35 34·38	6	35·15	47·32	− 47·83
	Lalande 32325	17 38 12·35	6	13·19	25·30	− 47·89
	γ Ophiuchi	17 42 45·84	6	46·77	58·95	− 47·82
	ξ Aquarii	21 32 16·58	6	17·40	29·44	− 47·96
	41 Capricorni	21 36 6·21	6	6·87	18·81	− 48·06
	π Aquarii	22 20 3·54	6	4·45	16·40	− 48·05
	σ Aquarii	22 25 12·69	6	13·48	25·37	− 48·11
Sept. 19	7 Sagittarii	17 56 40·28	6	41·06	37·45	− 63·61
	Lalande 33262	18 2 42·71	6	43·76	40·02	− 63·74
	B.A.C. 6347	18 32 54·54	6	55·34	51·64	− 63·70
	B.A.C. 6367	18 38 8·84	6	9·76	6·13	− 63·63
	B.A.C, 6388	18 41 58·04	6	58·98	55·28	− 63·70
	30 Sagittarii	18 44 48·31	6	49·11	45·39	− 63·72
	h^1 Aquarii	23 0 4·79	6	5·71	1·89	− 63·82
	c^2 Aquarii	23 4 13·68	6	14·47	10·61	− 63·86
	Lalande 45980	23 24 30·37	6	31·31	27·39	− 63·92
	16 Piscium	23 31 26·24	6	27·23	23·36	− 63·87
Dec. 23	o Piscium	1 39 51·18	6	52·20	11·30	− 40·90
	ξ Piscium	1 48 8·19	6	9·16	28·34	− 40·82
	ξ^1 Ceti	2 7 26·24	6	27·26	46·42	− 40·84
	67 Ceti	2 11 47·42	6	48·22	7·40	− 40·82
	B.A.C. 737	2 17 50·33	6	50·86	10·06	− 40·80
	ρ Ceti	2 20 56·61	6	57·33	16·52	− 40·81
	26 Monocerotis	7 36 18·71	6	19·48	38·73	− 40·75
	τ Navis	7 39 46·68	6	47·14	6·44	− 40·70
	o Puppis	7 43 53·19	6	53·71	13·06	− 40·65
	9 Argûs	7 47 0·48	6	1·19	20·55	− 40·64
	β Cancri	8 10 48·69	6	49·72	9·07	− 40·65
Dec. 29	Lalande 5211	2 42 55·88	6	56·51	18·38	− 38·13
	τ^2 Eridani	2 46 20·26	6	20·76	42·74	− 38·02
	Lalande 5424	2 50 34·14	6	35·06	56·99	− 38·07
	λ Ceti	2 54 2·51	6	3·44	25·32	− 38·12
Dec. 30	20 Eridani	3 31 33·63	6	34·20	56·66	− 37·54
	22 Eridani	3 35 26·62	6	27·38	49·78	− 37·60
	24 Eridani	3 39 9·77	6	10·58	32·92	− 37·66
	30 Eridani	3 47 30·80	6	31·55	53·90	− 37·65
	Lalande 7273	3 50 22·16	6	22·82	45·18	− 37·64
	Lalande 7384	3 53 42·34	6	43·09	5·48	− 37·61
	ν Tauri	3 58 1·64	6	32·56	54·90	− 37·66
	10 Monocerotis	6 22 47·05	6	47·82	10·28	− 37·54
	ξ^2 Canis Majoris	6 30 45·94	6	46·44	8·90	− 37·54
	15 Monocerotis	6 35 7·74	6	8·73	31·21	− 37·52
	18 Monocerotis	6 42 21·44	6	22·32	44·83	− 37·49
1882.						
Jan. 8	Lalande 9293	4 51 10·95	6	11·64	37·69	− 33·95
	64 Eridani	4 55 2·23	6	2·82	28·91	− 33·91
	B.A.C. 1559	4 57 57·49	6	57·86	23·98	− 33·88
	ι Leporis	5 7 23·09	6	23·69	49·76	− 33·93
Jan. 9	22 Eridani	3 35 22·50	6	23·14	49·71	− 33·43
	τ^6 Eridani	3 42 21·13	6	21·49	48·01	− 33·48
	Lalande 7273	3 50 18·16	6	18·70	45·10	− 33·60
	Lalande 7384	3 53 38·30	6	38·93	5·41	− 33·52
	μ Tauri	4 9 42·39	6	43·22	9·77	− 33·45

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.		h m s		s	s	s
Jan. 14	Lalande 5759	3 1 16·14	6	16·70	45·19	− 31·51
	τ^5 Eridani	3 29 7·63	6	7·93	36·15	− 31·78
22	Eridani	3 35 20·82	6	21·40	49·66	− 31·74
24	Eridani	3 39 3·94	6	4·58	32·80	− 31·78
	Lalande 7384	3 53 36·47	6	37·05	5·37	− 31·68
Jan. 17	Lalande 6248	3 16 46·78	6	46·95	16·26	− 30·69
	τ^5 Eridani	3 29 6·64	6	6·84	36·10	− 30·74
	W.B. IV–585	4 29 5·03	6	5·44	34·76	− 30·68
	10 Monocerotis	6 22 40·57	6	41·04	10·35	− 30·69
	15 Monocerotis	6 35 1·29	6	1·97	31·33	− 30·64
	18 Monocerotis	6 42 15·02	6	15·59	44·95	− 30·64
	19 Monocerotis	6 57 34·92	6	36·40	5·70	− 30·70
Jan. 20	30 Eridani	3 47 22·97	6	23·37	53·72	− 29·65
	ν Tauri	3 57 23·89	6	24·45	54·76	− 29·69
	W.B. IV–585	4 29 4·13	6	4·48	34·73	− 29·75
	54 Eridani	4 35 48·14	6	48·33	18·72	− 29·61
	ξ^2 Canis Majoris	6 30 38·49	6	38·64	8·95	− 29·69
	15 Monocerotis	6 35 0·43	6	1·05	31·33	− 29·72
	19 Monocerotis	6 57 34·97	6	35·39	5·71	− 29·68
	Lalande 13811	7 1 40·02	6	40·35	10·70	− 29·65
	20 Monocerotis	7 4 53·79	6	54·22	24·52	− 29·70
Jan. 21	44 Eridani	4 22 57·00	6	57·50	28·14	− 29·36
	45 Eridani	4 26 21·37	6	21·85	52·54	− 29·31
	W.B. IV–585	4 29 3·73	6	4·09	34·72	− 29·37
	Lalande 8736	4 32 10·72	6	11·16	41·85	− 29·31
	π^4 Orionis	4 45 26·19	6	26·75	57·40	− 29·35
	π^5 Orionis	4 48 37·29	6	37·81	8·47	− 29·34
	Lalande 13811	7 1 39·69	6	40·02	10·70	− 29·32
	20 Monocerotis	7 4 53·45	6	53·88	24·52	− 29·36
	26 Canis Majoris	7 7 54·18	6	54·30	24·98	− 29·32
	B.A.C. 2433	7 16 31·47	6	31·96	2·75	− 29·21
	ϵ Canis Minoris	7 19 43·23	6	43·85	14·49	− 29·36
Jan. 26	ν Tauri	3 57 21·96	6	22·41	54·70	− 27·71
	μ Tauri	4 9 36·78	6	37·26	9·61	− 27·65
	Lalande 9045	4 42 47·81	5	47·97	20·20	− 27·77
	π^4 Orionis	4 45 24·67	6	25·12	57·36	− 27·76
	π^5 Orionis	4 48 35·74	6	36·15	8·43	− 27·72
	Lalande 9293	4 51 4·95	6	5·26	37·56	− 27·70
	64 Eridani	4 54 56·18	6	56·41	28·76	− 27·65
	B.A.C. 1559	4 57 51·44	6	51·48	23·79	− 27·69
	1 Orionis	5 1 56·92	4	57·40	29·66	− 27·74
	τ Orionis	5 12 22·01	6	22·30	54·73	− 27·57
Jan. 27	44 Eridani	4 22 55·32	6	55·78	28·08	− 27·70
	45 Eridani	4 26 19·55	6	19·99	52·48	− 27·51
	W.B. IV–585	4 29 1·83	6	2·16	34·65	− 27·51
	54 Eridani	4 35 45·86	6	46·03	18·63	− 27·40
	Lalande 9045	4 42 47·45	4	47·67	20·19	− 27·48
	π^4 Orionis	4 45 24·44	6	24·95	57·35	− 27·60
	π^5 Orionis	4 48 35·35	6	35·82	8·42	− 27·40
	τ Orionis	5 12 21·84	6	22·20	54·72	− 27·48
Jan. 28	ν Tauri	3 57 21·40	6	21·90	54·67	− 27·23
	μ Tauri	4 9 36·21	6	36·74	9·58	− 27·16
	54 Eridani	4 35 45·58	6	45·74	18·62	− 27·12
	Lalande 9045	4 42 47·13	6	47·33	20·18	− 27·15
	π^4 Orionis	4 45 24·02	6	24·51	57·34	− 27·17
	π^5 Orionis	4 48 35·00	6	35·45	8·41	− 27·04
	Lalande 9293	4 51 4·24	6	4·59	37·54	− 27·05
	64 Eridani	4 54 55·56	6	55·82	28·74	− 27·08

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.		h m s		s	s	s
Jan. 28	B.A.C. 1559	4 57 50·79	6	50·85	23·76	− 27·09
	ι Leporis	5 7 16·44	6	16·71	49·60	− 27·11
	τ Orionis	5 12 21·42	6	21·75	54·71	− 27·04
	Lalande 10145	5 19 6·20	6	6·65	39·56	− 27·09
	σ Orionis	5 53 18·27	6	18·65	51·57	− 27·08
Feb. 13	υ Orionis	5 26 37·15	6	37·25	15·34	− 21·91
	c Orionis	5 29 57·74	6	57·87	35·91	− 21·96
	σ Orionis	5 33 13·15	6	13·30	51·38	− 21·92
	b Orionis	5 36 46·34	6	46·54	24·54	− 22·00
	γ Leporis	5 39 56·56	6	56·45	34·50	− 21·95
	W.B. VIII–986	8 20 19·08	6	19·16	57·36	− 21·80
	B.A.C. 2868	8 26 37·24	6	37·17	15·35	− 21·82
	δ Hydræ	8 31 48·85	6	49·11	27·20	− 21·91
	6 Hydræ	8 34 50·48	6	50·51	28·62	− 21·89
	B.A.C. 2954	8 38 17·02	6	17·12	55·30	− 21·82
Feb. 14	υ Orionis	5 26 36·84	6	36·92	15·33	− 21·59
	c Orionis	5 29 57·39	6	57·41	35·90	− 21·51
	σ Orionis	5 33 12·87	6	13·01	51·37	− 21·64
	b Orionis	5 36 45·99	6	46·18	24·53	− 21·65
	W.B. VIII–486	8 20 18·81	6	18·88	57·36	− 21·52
	B.A.C. 2868	8 26 36·91	6	36·83	15·34	− 21·49
	δ Hydræ	8 31 48·49	6	48·74	27·20	− 21·54
	6 Hydræ	8 34 50·08	6	50·10	28·62	− 21·48
	B.A.C. 2954	8 38 16·69	6	16·78	55·30	− 21·48
Feb. 15	7 Monocerotis	6 14 25·09	6	25·17	3·89	− 21·28
	8 Monocerotis	6 17 54·05	6	54·29	33·21	− 21·08
	15 Monocerotis	6 34 52·01	6	52·31	31·20	− 21·11
	18 Monocerotis	6 42 5·77	6	5·98	44·83	− 21·15
	B.A.C. 2433	7 16 23·57	6	23·75	2·68	− 21·07
	ε Canis Minoris	7 19 35·31	6	35·60	14·44	− 21·16
	B.A.C. 2470	7 22 42·34	6	42·39	21·18	− 21·21
	o Puppis	7 43 34·59	6	34·43	13·32	− 21·11
	9 Argûs	7 46 42·09	6	42·09	20·88	− 21·21
Feb. 17	7 Monocerotis	6 14 24·19	6	24·29	3·86	− 20·43
	8 Monocerotis	6 17 53·34	6	53·60	33·19	− 20·41
	15 Monocerotis	6 34 51·26	6	51·59	31·18	− 20·41
	18 Monocerotis	6 42 4·99	6	5·22	44·81	− 20·41
	B.A.C. 2433	7 16 22·80	6	23·01	2·66	− 20·35
	ε Canis Minoris	7 19 34·48	6	34·81	14·43	− 20·38
	B.A.C. 2470	7 22 41·45	6	41·53	21·17	− 20·36
	o Puppis	7 43 33·76	6	33·61	13·30	− 20·31
	9 Argûs	7 46 41·26	6	41·28	20·86	− 20·42

Digitized by Google

SECTION IV.—TABLE 5.

OBSERVATIONS WITH THE CAPE TRANSIT CIRCLE BY MR. FREEMAN.

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	m s
April 9	36 Sextantis	10 40 34·00	6	33·35	4·28	−1 29·07
	l Leonis	10 44 32·44	6	31·91	2·98	−1 28·93
	p^1 Leonis	10 57 18·06	6	17·33	48·26	−1 29·07
	χ Leonis	11 0 35·07	6	34·49	55·54	−1 28·95
	A^1 Virginis	11 43 20·62	6	20·06	51·03	−1 29·03
	η Crateris	11 51 30·13	6	29·18	0·13	−1 29·05
	Lalande 22585	11 56 10·87	6	10·03	41·05	−1 28·98
	B.A.C. 4077	12 1 26·99	6	26·26	57·23	−1 29·03
April 13	13 Sextantis	9 59 34·05	6	33·49	1·11	−1 32·38
	λ Hydræ	10 6 22·96	6	22·15	49·76	−1 32·39
	21 Sextantis	10 9 48·17	6	47·42	15·17	−1 32·25
	22 Sextantis	10 13 18·84	6	18·09	45·66	−1 32·43
	l Leonis	10 44 35·91	6	35·46	2·94	−1 32·52
	p^1 Leonis	10 57 21·27	6	20·62	48·24	−1 32·38
	χ Leonis	11 0 28·43	6	27·93	55·51	−1 32·42
April 14	ρ Leonis	10 28 9·19	6	8·72	35·41	−1 33·31
	36 Sextantis	10 40 37·94	6	37·35	4·24	−1 33·11
	7 Leonis	10 44 36·54	6	36·09	2·93	−1 33·16
	p^1 Leonis	10 57 22·11	6	21·44	48·23	−1 33·21
	χ Leonis	11 0 29·14	6	28·63	55·50	−1 33·13
	A^1 Virginis	11 43 24·76	6	24·27	51·01	−1 33·26
	η Crateris	11 51 34·37	6	33·44	0·12	−1 33·32
	B.A.C. 4077	12 1 31·09	6	30·40	57·22	−1 33·18
May 12	6 Corvi	12 18 11·06	6	9·97	12·68	−0 57·29
	B.A.C. 4200	12 22 46·14	6	45·41	48·19	−0 57·22
	Piazzi XII–111	12 26 32·64	6	31·90	34·58	−0 57·32
	B.A.C. 4238	12 29 28·36	6	27·84	30·61	−0 57·23
	m Virginis	13 36 23·46	6	22·67	25·33	−0 57·34
	86 Virginis	13 40 37·44	6	36·59	39·25	−0 57·34
	47 Hydræ	13 52 52·68	6	51·59	54·23	−0 57·36
	τ Virginis	13 56 36·72	6	36·10	38·69	−0 57·41
May 23	Lalande 23006	12 12 7·31	6	6·47	58·04	−1 8·43
	η Virginis	12 15 0·90	6	0·32	51·89	−1 8·43
	B.A.C. 4200	12 22 57·12	6	56·48	48·11	−1 8·37
	12 Libræ	14 48 38·98	6	37·97	29·40	−1 8·57
	δ Libræ	14 55 49·76	6	49·05	40·44	−1 8·61
	110 Virginis	14 58 5·87	6	5·34	56·71	−1 8·63
	ν Libræ	15 1 12·46	6	11·61	3·10	−1 8·51
June 16	*m* Virginis	13 35 58·04	6	57·10	25·19	−0 31·91
	86 Virginis	13 40 11·93	6	10·94	39·12	−0 31·82
	47 Hydræ	13 52 27·13	6	25·92	54·12	−0 31·80
	τ Virginis	13 56 11·17	6	10·40	38·59	−0 31·81
	30 Ophiuchi	16 55 23·97	6	23·10	50·94	−0 32·16
	Lalande 31606	17 18 12·81	6	11·67	39·42	−0 32·25
	B.A.C. 6367	18 37 39·49	6	38·55	6·36	−0 32·19
	B.A.C. 6388	18 41 28·52	6	27·64	55·50	−0 32·14
	30 Sagittarii	18 44 18·91	6	17·75	45·55	−0 32·20
	19 Aquilæ	19 3 46·47	6	45·75	13·82	−0 31·93
June 17	*m* Virginis	13 35 59·11	6	58·21	25·19	−0 33·02
	86 Virginis	13 40 12·84	6	11·87	39·11	−0 32·76
	47 Hydræ	13 52 28·21	6	27·01	54·11	−0 32·90
	τ Virginis	13 56 12·02	6	11·27	38·58	−0 32·69

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
June 17	41 Ophiuchi	17 11 7·62	6	6·83	33·94	− 32·89
	40 Ophiuchi	17 14 30·76	6	29·63	56·66	− 32·97
	Lalande 31606	17 18 13·31	6	12·19	39·43	− 32·76
	51 Ophiuchi	17 24 47·86	6	46·68	13·70	− 32·98
June 20	96 Virginis	14 3 19·88	6	19·13	43·52	− 35·61
	ι Virginis	14 10 26·00	6	25·31	49·78	− 35·53
	λ Virginis	14 13 19·94	6	19·14	43·66	− 35·48
	υ^2 Virginis	14 16 30·02	6	29·40	53·88	− 35·52
	Lalande 31210	17 4 43·64	6	42·84	7·32	− 35·52
	Lalande 31606	17 18 15·99	6	15·05	39·45	− 35·60
	57 Ophiuchi	17 32 2·86	6	2·14	26·62	− 35·52
June 21	96 Virginis	14 3 20·51	6	19·70	43·51	− 36·19
	ι Virginis	14 10 26·85	6	26·11	49·78	− 36·33
	λ Virginis	14 13 20·74	6	19·88	43·66	− 36·22
	υ^2 Virginis	14 16 30·82	6	30·15	53·88	− 36·27
	20 Aquilæ	19 6 54·43	6	53·65	17·32	− 36·33
	υ Sagittarii	19 15 36·11	6	35·19	58·79	− 36·40
	e Aquilæ	19 25 7·27	6	6·57	30·24	− 36·33
June 22	96 Virginis	14 3 21·28	6	20·53	43·50	− 37·03
	ι Virginis	14 10 27·49	6	26·81	49·77	− 37·04
	λ Virginis	14 13 21·54	6	20·74	43·65	− 37·09
	υ^2 Virginis	14 16 31·35	6	30·73	53·87	− 36·86
	Lalande 31210	17 4 45·36	6	44·56	7·33	− 37·23
	Lalande 31606	17 18 17·58	6	16·65	39·47	− 37·18
	μ Ophiuchi	17 32 4·53	6	3·80	26·63	− 37·17
June 27	109 Virginis	14 41 0·04	6	59·39	17·28	− 42·11
	12 Libræ	14 48 12·68	6	11·58	29·36	− 42·22
	δ Libræ	14 55 23·28	6	22·47	40·41	− 42·06
	ν Libræ	15 0 46·11	6	45·17	3·09	− 42·08
	μ^1 Sagittarii	18 7 26·58	6	25·57	43·20	− 42·37
	Lalande 33596	18 10 53·08	5	52·46	10·27	− 42·19
	Rumker 6386	18 14 10·94	6	10·39	28·09	− 42·30
	21 Sagittarii	18 19 3·54	6	2·53	20·17	− 42·36
Aug. 18	40 Ophiuchi	17 14 28·38	6	28·80	56·47	− 32·33
	B.A.C. 5890	17 20 54·35	6	54·94	22·78	− 32·16
	51 Ophiuchi	17 24 45·33	6	45·72	13·56	− 32·16
	o Serpentis	17 35 19·36	6	19·87	47·56	− 32·31
	α^1 Capricorni	20 11 39·41	6	39·91	7·53	− 32·38
	B.A.C. 7014	20 17 52·86	6	53·55	21·07	− 32·48
	ρ Capricorni	20 22 40·84	6	41·29	8·91	− 32·38
	Washington 8892	20 25 0·66	6	1·14	28·76	− 32·38
Aug. 19	37 Ophiuchi	17 7 26·88	6	27·76	54·52	− 33·24
	41 Ophiuchi	17 11 6·09	6	6·85	33·69	− 33·16
	40 Ophiuchi	17 14 29·13	6	29·65	56·46	− 33·19
	51 Ophiuchi	17 24 46·29	6	46·78	13·55	− 33·23
	ζ Capricorni	21 20 29·91	6	30·41	57·05	− 33·36
	8 Piscis Australis	21 29 54·48	6	54·93	21·65	− 33·28
	ξ Aquarii	21 32 2·03	6	2·70	29·42	− 33·28
	41 Capricorni	21 35 51·74	6	52·23	18·78	− 33·45
Aug. 25	51 Ophiuchi	17 24 51·69	6	52·30	13·46	− 38·84
	o Serpentis	17 35 25·48	6	26·17	47·47	− 38·70
	Lalande 32633	17 46 32·04	6	32·82	54·03	− 38·79
	B.A.C. 6060	17 49 37·16	6	37·81	59·14	− 38·67
	B.A.C. 6111	17 58 35·03	6	35·63	56·95	− 38·68

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
Aug. 25	Lalande 40029	20 38 27·27	6	28·10	49·35	−38·75
	ϵ Aquarii	20 41 56·61	6	57·32	18·44	−38·88
	ω Capricorni	20 45 26·24	6	26·80	47·93	−38·87
	19 Capricorni	20 48 47·14	6	47·78	8·95	−38·83
Aug. 26	51 Ophiuchi	17 24 52·51	6	53·11	13·44	−39·67
	o Serpentis	17 35 26·39	6	27·10	47·45	−39·65
	Lalande 32633	17 46 32·77	6	33·59	54·02	−39·57
	B.A.C. 6060	17 49 38·13	6	38·77	59·12	−39·65
	B.A.C. 6111	17 58 35·99	6	36·59	56·94	−39·65
	ρ Capricorni	20 22 47·88	6	48·53	8·89	−39·64
	Lalande 40029	20 38 28·34	6	29·22	49·35	−39·87
	ω Capricorni	20 45 27·23	6	27·80	47·93	−39·87
	19 Capricorni	20 48 48·13	6	48·78	8·95	−39·83
	η Capricorni	20 58 21·66	6	22·30	42·55	−39·75
	ν Aquarii	21 3 50·19	6	50·91	11·11	−39·80
Aug. 27	B.A.C. 5890	17 21 2·62	6	3·39	22·65	−40·74
	o Serpentis	17 35 27·49	6	28·17	47·44	−40·73
	Lalande 32633	17 46 33·97	6	34·77	54·00	−40·77
	B.A.C. 6060	17 49 39·26	6	39·89	59·11	−40·78
	B.A.C. 6111	17 58 37·06	6	37·62	56·92	−40·70
	ρ Capricorni	20 22 49·24	6	49·86	8·89	−40·97
	Lalande 40029	20 38 29·35	6	30·21	49·34	−40·87
	ω Capricorni	20 45 28·24	6	28·77	47·92	−40·85
	19 Capricorni	20 48 49·24	6	49·86	8·95	−40·91
Aug. 28	o Serpentis	17 35 28·69	6	29·34	47·42	−41·92
	B.A.C. 6060	17 49 40·41	6	41·00	59·09	−41·91
	B.A.C. 6347	18 32 33·39	6	33·95	51·99	−41·96
	30 Sagittarii	18 44 27·13	6	27·69	45·73	−41·96
	Lalande 40029	20 38 30·65	6	31·48	49·34	−42·14
	ϵ Aquarii	20 41 59·81	6	0·50	18·42	−42·08
	ω Capricorni	20 45 29·58	6	30·07	47·92	−42·15
	19 Capricorni	20 48 50·43	6	51·02	8·95	−42·07
Sept. 19	d Sagittarii	19 11 47·16	6	47·92	44·41	−63·51
	υ Sagittarii	19 16 1·44	6	2·22	58·76	−63·46
	e Aquilæ	19 25 32·90	6	33·78	30·23	−63·55
	47 Aquilæ	19 38 3·99	6	4·99	1·64	−63·35
	υ Aquilæ	19 40 58·77	6	59·74	56·27	−63·47
	63 Sagittarii	19 56 25·46	6	26·26	22·76	−63·50
	8 Piscis Australis	21 30 24·49	6	25·18	21·55	−63·63
	ξ Aquarii	21 32 31·98	6	32·83	29·37	−63·46
	41 Capricorni	21 36 21·44	6	22·16	18·73	−63·43
	27 Aquarii	21 42 18·87	6	19·80	16·20	−63·60
	B.A.C. 7649	21 53 12·83	6	13·56	10·12	−63·44
	B.A.C. 7665	21 56 46·13	6	46·89	43·34	−63·55
Dec. 23	ζ Eridani	3 10 47·76	6	48·43	7·96	−40·47
	Lacaille 1051	3 13 50·98	6	51·47	11·03	−40·44
	Lalande 6248	3 16 56·54	6	57·00	16·55	−40·45
	Lalande 6476	3 24 43·41	6	44·03	3·53	−40·50
	19 Monocerotis	6 58 15·10	6	15·84	5·47	−40·37
	Lalande 13811	7 1 50·08	4	50·72	10·47	−40·25
	20 Monocerotis	7 5 3·92	6	4·66	24·26	−40·40
	B.A.C. 2433	7 16 41·90	6	42·69	2·37	−40·32
	B.A.C. 2470	7 23 0·68	6	1·33	21·27	−40·06

Digitized by Google

Date.	Name of Star.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.		h m s		s	s	s
Dec. 29	ζ Eridani	3 10 44·98	6	45·66	7·92	−37·74
	Lacaille 1051	3 13 48·24	6	48·71	10·98	−37·73
20	Eridani	3 31 33·78	6	34·33	56·67	−37·66
24	Eridani	3 39 9·97	6	10·76	32·92	−37·84
1882.						
Jan. 9	Lalande 5424	2 50 29·42	6	30·23	56·89	−33·34
	Lacaille 1051	3 13 43·88	6	44·24	10·85	−33·39
44	Eridani	4 23 0·89	6	1·61	28·24	−33·37
	Lalande 8736	4 32 14·44	6	15·10	41·94	−33·16
Jan. 21	64 Eridani	4 54 57·64	6	57·94	28·82	−29·12
	B.A.C. 1559	4 57 52·89	6	52·97	23·86	−29·11
	ι Leporis	5 7 18·48	6	18·79	49·68	−29·11
	τ Orionis	5 12 23·62	6	24·00	54·77	−29·23
	66 Orionis	5 59 15·22	6	15·77	46·73	−29·04
	B.A.C. 1994	6 6 38·40	6	38·79	9·60	−29·19
	7 Monocerotis	6 14 32·94	6	33·31	4·10	−29·21
	8 Monocerotis	6 18 1·97	6	2·52	33·38	−29·14
	15 Monocerotis	6 34 59·81	6	0·44	31·33	−29·11
Feb. 13	7 Monocerotis	6 14 25·57	6	25·66	3·91	−21·75
	8 Monocerotis	6 17 54·82	6	55·06	33·23	−21·83
	15 Monocerotis	6 34 52·61	6	52·92	31·22	−21·70
	18 Monocerotis	6 42 6·24	6	6·45	44·85	−21·60
	B.A.C. 2433	7 16 24·15	6	24·34	2·69	−21·65
	ε Canis Minoris	7 19 35·93	6	36·24	14·46	−21·78
	B.A.C. 2470	7 22 42·93	6	42·97	21·20	−21·77
	o Puppis	7 43 35·23	6	35·07	13·34	−21·73
	9 Argûs	7 46 42·59	6	42·59	20·89	−21·70
Feb. 14	7 Monocerotis	6 14 25·15	6	25·24	3·90	−21·34
	8 Monocerotis	6 17 54·25	6	54·50	33·22	−21·28
	15 Monocerotis	6 34 52·13	6	52·45	31·21	−21·24
	18 Monocerotis	6 42 6·02	6	6·24	44·84	−21·40
	ε Canis Minoris	7 19 35·61	6	35·93	14·45	−21·48
	B.A.C. 2470	7 22 42·51	6	42·55	21·19	−21·36
	o Puppis	7 43 34·73	6	34·56	13·33	−21·23
	9 Argûs	7 46 42·21	6	42·22	20·88	−21·34
Feb. 15	υ Orionis	5 26 36·24	6	36·36	15·31	−21·05
	c Orionis	5 29 56·67	6	56·83	35·88	−20·95
	σ Orionis	5 33 12·14	6	12·32	51·35	−20·97
	b Orionis	5 36 45·29	6	45·53	24·51	−21·02
	γ Leporis	5 39 55·63	6	55·53	34·46	−21·07
	W.B. VIII–486	8 20 18·29	6	18·40	57·36	−21·04
	B.A.C. 2868	8 26 36·48	6	36·43	15·34	−21·09
	δ Hydræ	8 31 47·97	6	48·27	27·19	−21·08
	6 Hydræ	8 34 49·59	6	49·65	28·61	−21·04
	B.A.C. 2954	8 38 16·09	6	16·22	55·30	−20·92
Feb. 17	υ Orionis	5 26 35·44	6	35·49	15·28	−20·21
	c Orionis	5 29 55·99	6	56·07	35·85	−20·22
	σ Orionis	5 33 11·29	6	11·40	51·32	−20·08
	b Orionis	5 36 44·60	6	44·77	24·48	−20·29
	γ Leporis	5 39 54·83	6	54·66	34·43	−20·23
	W.B. VIII–486	8 20 17·44	6	17·47	57·35	−20·12
	δ Hydræ	8 31 47·07	6	47·29	27·19	−20·10
	6 Hydræ	8 34 48·68	6	48·66	28·61	−20·05
	B.A.C. 2954	8 38 15·32	6	15·39	55·30	−20·09

Digitized by Google

Digitized by Google

SECTION V.

OBSERVATIONS WITH CAPE HUT-TRANSIT.

		Page
TABLE 1.	—Mr. Finlay's Determinations of Collimation Error - - -	36
„ 2.	— „ „ Level Error - - -	36
„ 3.	— „ „ Azimuth Error - - -	37
„ 4.	— „ Transit Observations - - - - -	40
„ 5.	—Mr. Maclear's Determinations of Collimation Error - -	44
„ 6.	— „ „ Level Error - - -	44
„ 7.	— „ „ Azimuth Error - - -	45
„ 8.	— „ Transit Observations - - - -	48
„ 9.	—Mr. Pett's Determinations of Collimation Error - - -	51
„ 10.	— „ „ Level Error - - -	52
„ 11.	— „ „ Azimuth Error - - -	52
„ 12.	— „ Transit Observations - - - -	53

Digitized by Google

SECTION V.—TABLE 1.

DETERMINATIONS OF COLLIMATION ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Observation.	
			Lamp W.	Lamp E.
1881.	r	r	s	s
Apr. 9	10·511	10·500	−0·058	+0·024
14	10·519	10·500	−0·073	+0·039
Dec. 17	10·532	10·500		+0·101
23	10·536	10·500	−0·151	+0·117
30	10·527	10·500	−0·118	+0·084
1882.				
Jan. 15	10·552	10·500	−0·212	+0·178
16	10·542	10·500	−0·174	+0·140
17	10·545	10·500	−0·185	+0·151
20	10·545	10·500	−0·185	+0·151
1882.	r	r	s	s
Jan. 26	10·499	10·500	−0·013	−0·021
27	10·547	10·500	−0·193	+0·159
28	10·532	10·500	−0·137	+0·103
Feb. 14	10·525	10·500	−0·109	+0·075
15	10·533	10·500	−0·141	+0·107
May 27	10·550	10·550	−0·017	−0·017
July 10	10·576	10·550	−0·114	+0·080
13	10·554	10·545	−0·051	+0·017
1883.				
Jan. 3	10·664	10·500	−0·631	+0·597

SECTION V.—TABLE 2.

DETERMINATIONS OF LEVEL ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s
April 9	W.	+1·39	+0·123
	W.	+1·51	
	E.	+1·13	+0·086
	E.	+0·88	
14	W.	+3·75	+0·319
	E.	+5·10	+0·404
	E.	+4·18	
May 12	E.	−0·25	−0·026
	E.	−0·36	
	W.	−0·83	−0·070
20	E.	+8·84	+0·766
	E.	+8·76	
	Level altered.		
23	E.	−4·55	−0·407
	W.	−7·52	−0·654
	W.	−5·70	−0·496*
December 23	E.	+1·18	+0·106
	E.	+1·10	
	W.	−0·23	−0·021
	W.	+0·03	+0·002*
	E.	+2·10	+0·195
	E.	+1·18	+0·110*
	W.	+0·71	+0·066
	W.	+1·24	+0·115*
30	E.	−0·96	−0·098
	E.	−1·29	
	W.	−0·78	−0·046
	W.	−0·29	
1882.		d	s
January 14	E.	+1·35	+0·119
	E.	+1·38	
15	W.	+3·33	+0·300
	W.	+3·56	
	E.	+2·81	+0·229
	E.	+2·45	
16	E.	+3·36	+0·285
	E.	+3·20	
	W.	+3·55	+0·335
	W.	+4·15	
17	E.	+5·53	+0·457
	E.	+4·98	
	W.	+4·84	+0·432
	W.	+5·10	
20	E.	−0·75	−0·082
	E.	−1·14	
	W.	−0·74	−0·048
	W.	−0·35	
26	W.	+1·06	+0·102
	W.	+1·40	
	E.	+1·10	+0·066
	E.	+0·40	
27	W.	+1·43	+0·150
	W.	+2·03	
	E.	+1·81	+0·158
	E.	+0·88	+0·076*

Digitized by Google

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		d	s
January 28	W.	+1·58	+0·157
	W.	+2·04	
	E.	+2·94	+0·247
	E.	+2·74	
February 13	W.	+0·55	+0·048
	E.	+1·20	+0·080
	E.	+0·64	
14	E.	+1·13	+0·091
	E.	+0·98	
	W.	+1·39	+0·121
15	W.	+2·08	+0·196
	W.	+2·44	
	E.	+1·71	+0·149
17	W.	+5·70	+0·496
	E.	+5·60	+0·487
	E.	+4·88	+0·424*
May 22	E.	+4·46	+0·389
	W.	+3·96	+0·345
	W.	+5·33	+0·463*
27	E.	+3·40	+0·296
	E.	+2·76	+0·240*
	W.	+3·06	+0·266
1882.		d	s
July 10	W.	+3·75	+0·320
	W.	+3·61	
	E.	+3·41	+0·280
	E.	+3·04	
	E.	+2·83	+0·246
	E.	+0·43	+0·037*
	W.	+1·55	+0·135
	W.	+3·01	+0·262*
13	W.	+1·70	+0·160
	W.	+1·96	
	E.	+1·80	+0·157
	E.	+0·75	+0·065*
	E.	+1·80	+0·157
	E.	+0·63	+0·054*
	W.	+0·58	+0·050
	W.	+1·93	+0·167*
1883.			
January 20	E.	+1·90	+0·165
	W.	+2·23	+0·217
	W.	+2·75	
22	E.	−1·38	−0·131
	E.	−1·63	
	W.	+0·25	+0·021

SECTION V.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
April 9	W.	Lacaille 8798 S.P. -	9 33 7·98	9 32 29·94	−0·829
		Lacaille 4169 - -	9 48 8·41	9 47 44·88	
	E.	Lacaille 248 S.P. -	12 40 11·70	12 39 28·12	−0·857
		ι Octantis - -	12 43 19·74	12 42 54·67	
April 14	W.	Lacaille 9123 S.P. -	10 31 12·62	10 30 32·57	−0·290
		Lacaille 4578 - -	10 47 48·43	10 47 14·51	
	E.	Lacaille 9464 S.P. -	11 28 4·43	11 27 23·35	−0·201
		Lacaille 4865 - -	11 35 31·62	11 34 55·61	
May 12	E.	Lacaille 9464 S.P. -	11 27 51·00	11 27 31·29	+0·923
		Lacaille 4865 - -	11 35 34·63	11 34 51·60	
	W.	z Octantis - -	14 33 14·38	14 32 17·52	+1·098
May 23	E.	Lacaille 248 S.P. -	12 40 12·01	12 39 34·20	−0·355
		Lacaille 5325 - -	12 55 27·09	12 54 59·37	
	W.	Lacaille 634 S.P. -	13 44 43·42	13 44 7·67	−0·277

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuthal Error.
			h m s	h m s	s
1881.					
Dec. 23	E.	z Octantis S.P. - -	2 33 5·42	2 31 44·31	−2·170
		Lacaille 1029 - -	2 38 39·96	2 38 30·32	
	W.	Lacaille 1222 - -	3 32 5·15	3 31 37·51	−2·466
		Lacaille 6484 S.P. -	3 44 16·51	3 43 29·88	
	E.	Lacaille 3274 - -	7 28 14·56	7 28 12·97	−2·411
		Lacaille 8094 S.P. -	7 34 57·53	7 34 6·15	
	W.	A Octantis - - -	8 5 47·12	8 6 29·56	−2·505
		Lacaille 8360 S.P. -	8 19 1·64	8 18 9·25	
Dec. 30	E.	Lacaille 1592 - -	4 5 0·85	4 4 39·17	−2·136
		Lacaille 6727 S.P. -	4 16 15·35	4 15 21·69	
	W.	Lacaille 2426 - -	6 21 20·87	6 20 50·58	−2·416
		σ Octantis S.P. - -	6 30 13·27	6 26 50·95	
1882.					
Jan. 17	E.	Brisbane 5607 S.P. -	4 18 54·16	4 17 11·57	−2·789
		Lacaille 1839 - -	4 34 54·22	4 34 24·05	
	W.	Lacaille 2210 - -	5 59 15·01	5 58 19·87	−3·025
		σ Octantis S.P. - -	6 31 29·55	6 27 3·91	
Jan. 20	E.	Lacaille 1592 - -	4 5 15·88	4 4 33·64	−2·863
		Brisbane 5607 S.P. -	4 19 0·93	4 17 12·59	
	W.	σ Octantis S.P. - -	6 31 51·39	6 27 8·62	−3·207
		ζ Mensæ - - -	6 50 54·65	6 49 56·99	
Jan. 26	W.	Brisbane 5607 S.P. -	4 18 18·13	4 17 14·72	−3·217
		Lacaille 1839 - -	4 34 0·73	4 34 20·89	
	E.	Lacaille 2066 - -	5 25 32·56	5 25 33·37	−3·245
		Lacaille 7184 S.P. -	5 30 26·16	5 29 38·88	
Jan. 27	W.	Lacaille 6817 S.P. -	4 26 55·63	4 26 16·45	−3·316
		Lacaille 1752 - -	4 58 54·23	4 58 37·60	
	E.	Brisbane 6058 S.P. -	5 46 44·10	5 45 12·59	−3·113
		Lacaille 2296 - -	5 53 11·27	5 53 11·48	
Jan. 28	W.	Lacaille 1592 - -	4 4 25·21	4 4 31·22	−3·329
		Brisbane 5607 S.P. -	4 18 26·31	4 17 15·45	
	E.	Lacaille 2066 - -	5 25 37·55	5 25 32·98	−3·170
		Lacaille 7184 S.P. -	5 30 30·79	5 29 39·24	
Feb. 13	W.	σ Octantis S.P. - -	6 32 12·39	6 27 41·90	−3·246
		ζ Mensæ - - -	6 50 37·92	6 49 54·82	
	E.	Lacaille 3274 - -	7 28 19·34	7 28 6·62	−3·164
		Lacaille 8094 S.P. -	7 35 27·07	7 34 8·99	
Feb. 14	E.	Brisbane 6058 S.P. -	5 47 26·00	5 45 22·30	−3·043
		Lacaille 2296 - -	5 53 41·45	5 53 7·36	
	W.	A Octantis - - -	8 5 41·49	8 6 22·59	−3·214
		Lacaille 8257 S.P. -	8 15 38·12	8 14 6·16	
Feb. 15	W.	Brisbane 6058 S.P. -	5 47 33·62	5 45 22·89	−3·290
		Lacaille 2296 - -	5 53 40·93	5 53 7·10	
	E.	A Octantis - - -	8 5 45·52	8 6 21·95	−3·126
		Lacaille 8257 S.P. -	8 15 39·31	8 14 6·31	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuthal Error.
			h m s	h m s	s
1882.					
Feb. 17	W.	σ Octantis S.P. - -	6 32 41·42	6 27 49·29	−3·451
		ζ Mensæ - - -	6 50 44·77	6 49 54·35	
	E.	Lacaille 3274 - -	7 28 23·84	7 28 5·40	−3·301
		Lacaille 8094 S.P. -	7 35 36·11	7 34 9·48	
May 22	E.	Lacaille 4991 - -	11 57 39·18	11 56 40·53	−1·065
		Lacaille 9745 S.P. -	12 3 35·35	12 2 11·37	
	W.	Lacaille 235 S.P. -	12 45 38·43	12 44 26·54	−1·450
		Lacaille 5325 - -	12 55 56·23	12 55 11·45	
May 27	E.	Lacaille 4643 - -	11 0 24·33	11 0 10·45	−0·165
		τ Octantis S.P. - -	11 9 53·52	11 9 34·17	
	W.	κ Octantis - - -	13 22 37·03	13 22 26·09	−0·325
		Lacaille 634 S.P. -	13 44 19·46	13 44 2·00	
July 10	W.	Lacaille 1105 S.P. -	15 12 46·16	15 11 28·35	+0·161
		Lacaille 6216 - -	15 17 57·39	15 16 37·58	
	E.	Lacaille 1592 S.P. -	16 5 18·68	16 4 6·03	+0·561
		Brisbane 5607 - -	16 19 14·32	16 17 48·71	
	E.	σ Octantis - - -	18 33 2·54	18 31 16·66	+0·411
		ζ Mensæ S.P. - -	18 50 55·69	18 49 38·74	
	W.	Lacaille 8094 - -	19 35 49·12	19 34 29·90	+0·046
		Lacaille 3238 S.P. -	19 58 2·16	19 56 43·45	
July 13	W.	Lacaille 1105 S.P. -	15 12 50·97	15 11 28·64	+0·031
		Lacaille 6216 - -	15 17 59·87	15 16 37·15	
	E.	Lacaille 1592 S.P. -	16 5 27·33	16 4 6·56	+0·165
		Brisbane 5607 - -	16 19 12·81	16 17 48·22	
	E.	σ Octantis - - -	18 32 42·11	18 31 16·90	+0·049
		ζ Mensæ S.P. - -	18 51 0·50	18 49 38·76	
	W.	Lacaille 3274 S.P. -	19 28 39·88	19 27 15·55	−0·084
		Lacaille 8094 - -	19 35 52·63	19 34 30·03	
1883.					
Jan. 22	E.	Lacaille 6817 S.P. -	4 26 24·03	4 27 27·08	+0·917
	W.	Lacaille 2426 - -	6 20 43·07	6 21 55·10	+0·937

Digitized by Google

SECTION V.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	m s
Apr. 9	Lalande 19241 - - -	W.	9 42 52·31	5	51·97	20·48	−0 31·49
	13 Sextantis - - -		9 58 33·07	5	32·61	1·16	−0 31·45
	λ Hydræ - - -		10 5 21·57	5	21·31	49·80	−0 31·51
	21 Sextantis - - -		10 8 47·07	5	46·75	15·21	−0 31·54
	22 Sextantis - - -		10 12 17·53	5	17·21	45·70	−0 31·51
	η Virginis - - -	E.	12 14 24·15	5	23·77	52·09	−0 31·68
	6 Corvi - - - -		12 17 44·59	5	44·55	12·80	−0 31·75
	B.A.C. 4200 - - -		12 22 20·33	5	20·00	48·29	−0 31·71
	Piazzi XII–111 - -		12 26 6·67	5	6·36	34·67	−0 31·69
Apr. 14	ρ Leonis - - -	W.	10 27 12·75	5	12·70	35·41	−0 37·29
	36 Sextantis - - -		10 39 41·57	5	41·57	4·24	−0 37·33
	l Leonis - - -		10 43 40·27	5	40·21	2·93	−0 37·28
	p^1 Leonis - - -		10 56 25·49	5	25·53	48·23	−0 37·30
	χ Leonis - - -		10 59 32·77	5	32·73	55·50	−0 37·23
	A^1 Virginis - - -	E.	11 42 28·29	5	28·50	51·01	−0 37·49
	η Crateris - - -		11 50 37·29	5	37·68	0·12	−0 37·56
	B.A.C. 4077 - - -		12 2 34·55	5	34·83	57·22	−0 37·61
	η Virginis - - -		12 14 29·38	4	29·66	52·09	−0 37·57
May 12	A^1 Virginis - - -	E.	11 42 25·29	5	26·01	50·81	−0 35·20
	η Crateris - - -		11 50 34·81	5	35·18	59·94	−0 35·24
	Lalande 22585 - -		11 55 15·65	5	16·11	40·88	−0 35·23
	B.A.C. 4077 - - -		12 0 31·75	5	32·31	57·07	−0 35·24
	λ Virginis - - -	W.	14 13 18·65	5	18·84	43·73	−0 35·11
	B.A.C. 4773 - - -		14 18 53·81	4	54·33	19·29	−0 35·04
	φ Virginis - - -		14 22 42·29	5	42·67	7·65	−0 35·02
May 23	B.A.C. 4382 - - -	E.	13 0 46·77	5	46·34	13·46	−0 32·88
	θ Virginis - - -		13 4 23·81	5	23·37	50·44	−0 32·93
	54 Virginis - - -		13 7 41·85	5	41·43	8·49	−0 32·94
	86 Virginis - - -	W.	13 40 12·75	5	11·92	39·23	−0 32·69
	τ Virginis - - -		13 56 12·19	5	11·45	38·69	−0 32·76
	ι Virginis - - -		14 10 23·33	5	22·63	49·88	−0 32·75
Dec. 23	σ Ceti - - - -	E.	2 27 7·89	5	7·41	31·27	−0 36·14
	τ^2 Eridani - - -		2 46 19·27	5	19·01	42·80	−0 36·21
	Lalande 5424 - - -		2 50 34·61	5	33·35	57·03	−0 36·32
	λ Ceti - - -		2 54 2·95	5	1·67	25·36	−0 36·31
	Lalande 6476 - - -	W.	3 24 40·59	5	39·51	3·53	−0 35·98
	22 Eridani - - -		3 35 27·07	5	25·73	49·82	−0 35·91
	24 Eridani - - -		3 39 10·41	5	8·93	32·95	−0 35·98
	30 Eridani - - -		3 47 31·25	5	29·93	53·93	−0 36·00
	Lalande 13811 - -	E.	7 1 47·41	5	46·75	10·47	−0 36·28
	20 Monocerotis - -		7 5 1·49	5	0·56	24·26	−0 36·30
	26 Canis Majoris - -		7 8 1·08	5	1·02	24·77	−0 36·25
	B.A.C. 2405 - - -		7 12 29·88	5	29·89	53·37	−0 36·52
	B.A.C. 2846 - - -	W.	8 23 31·92	5	31·45	55·25	−0 36·20
	B.A.C. 2868 - - -		8 26 51·91	5	51·18	14·81	−0 36·37
	δ Hydræ - - -		8 32 4·43	5	2·74	26·55	−0 36·19
	6 Hydræ - - -		8 35 5·27	5	4·26	28·02	−0 36·24

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	m s
Dec. 30	Lalande 7273	E.	3 50 28·79	5	27·99	45·18	−0 42·81
	Lalande 7384		3 53 49·33	5	48·31	5·48	−0 42·83
	ν Tauri		3 57 39·13	5	37·76	54·90	−0 42·86
	μ Tauri		4 9 54·17	5	52·73	9·82	−0 42·91
	5 Monocerotis	W.	6 9 52·51	5	51·22	8·35	−0 42·87
	7 Monocerotis		6 14 48·23	5	47·00	4·05	−0 42·95
	15 Monocerotis		6 35 15·91	5	14·06	31·21	−0 42·85
	18 Monocerotis		6 42 29·29	5	27·69	44·83	−0 42·86
1882.							
Jan. 17	44 Eridani	E.	4 23 35·85	5	34·76	28·18	−1 6·58
	45 Eridani		4 26 59·97	5	58·95	52·58	−1 6·37
	W.B. IV.–585		4 29 41·79	5	41·18	34·76	−1 6·42
	Lalande 8935		4 39 34·31	5	33·68	27·23	−1 6·45
	B.A.C. 1965	W.	6 2 45·95	4	45·59	39·15	−1 6·44
	B.A.C. 1994		6 7 17·25	5	16·05	9·61	−1 6·44
	5 Monocerotis		6 10 15·97	5	14·74	8·40	−1 6·34
	7 Monocerotis		6 15 11·64	4	10·49	4·11	−1 6·38
Jan. 20	44 Eridani	E.	4 23 41·09	5	39·52	28·15	−1 11·37
	45 Eridani		4 27 5·31	5	3·80	52·56	−1 11·24
	W.B. IV–585		4 29 47·17	5	46·03	34·73	−1 11·30
	Lalande 8736		4 32 54·53	5	53·12	41·86	−1 11·26
	ξ Geminorum	W.	6 39 56·39	5	53·76	42·63	−1 11·13
	18 Monocerotis		6 42 58·33	5	56·19	44·95	−1 11·24
	B.A.C. 2291		6 55 0·26	5	59·47	48·22	−1 11·25
	19 Monocerotis		6 58 18·79	5	16·96	5·71	−1 11·25
Jan. 26	45 Eridani	W.	4 26 16·78	3	15·07	52·49	−0 22·58
	Lalande 8935		4 38 51·14	2	49·84	27·14	−0 22·70
	Lalande 9045		4 42 43·97	4	43·09	20·20	−0 22·89
	π^4 Orionis		4 45 22·19	5	20·22	57·35	−0 22·87
	π^5 Orionis		4 48 32·99	3	31·16	8·43	−0 22·73
	Lalande 9293		4 51 1·77	5	0·30	37·56	−0 22·74
	64 Eridani		4 54 52·65	5	51·55	28·76	−0 22·79
	o Orionis	E.	5 16 10·82	4	9·07	46·45	−0 22·62
	Lalande 10145		5 19 3·98	3	2·12	39·58	−0 22·54
	b Orionis		5 36 49·25	5	47·40	24·74	−0 22·66
	γ Leporis		5 39 58·02	4	57·37	34·74	−0 22·63
	Lalande 11047		5 43 59·93	5	57·68	35·00	−0 22·68
Jan. 27	Lalande 8935	W.	4 38 53·40	1	51·92	27·13	−0 24·79
	π^4 Orionis		4 45 24·46	3	22·28	57·34	−0 24·94
	π^5 Orionis		4 48 35·10	2	33·08	8·42	−0 24·66
	λ Eridani		5 3 58·29	5	56·82	31·94	−0 24·88
	ι Leporis		5 7 15·77	5	14·44	49·62	−0 24·82
	τ Orionis		5 12 21·13	5	19·56	54·72	−0 24·84
	o Orionis		5 16 13·27	5	11·39	46·44	−0 24·95
	b Orionis	E.	5 36 51·37	5	49·84	24·73	−0 25·11
	γ Leporis		5 40 0·17	4	59·81	34·73	−0 25·08
	B.A.C. 1965		6 2 4·58	4	4·21	39·08	−0 25·13
Jan. 28	44 Eridani	W.	4 22 56·99	5	55·06	28·07	−0 26·99
	45 Eridani		4 26 21·21	5	19·36	52·47	−0 26·89
	W.B. IV–585		4 29 3·15	5	1·74	34·63	−0 27·11
	Lalande 8736		4 32 10·43	5	8·69	41·77	−0 26·92
	o Orionis	E.	5 16 15·19	5	13·75	46·43	−0 27·32
	Lalande 10145		5 19 8·35	5	6·80	39·56	−0 27·24
	b Orionis		5 36 53·61	5	52·07	24·72	−0 27·35
	γ Leporis		5 40 2·27	5	1·96	34·72	−0 27·24

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
Feb. 13	7 Monocerotis	W.	6 15 3·29	5	1·81	3·91	−0 57·90
	8 Monocerotis		6 18 33·17	5	31·09	33·23	−0 57·86
	15 Monocerotis		6 35 31·33	5	28·97	31·22	−0 57·75
	18 Monocerotis		6 42 44·73	5	42·73	44·85	−0 57·88
	B.A.C. 2433	E.	7 17 2·31	5	0·69	2·69	−0 58·00
	ε Canis Minoris		7 20 14·45	5	12·41	14·46	−0 57·95
	B.A.C. 2470		7 23 20·37	5	19·30	21·20	−0 58·10
	o Puppis		7 44 11·70	5	11·36	13·34	−0 58·02
	9 Argûs		7 47 19·97	5	19·00	20·89	−0 58·11
Feb. 14	υ Orionis	E.	5 27 16·67	5	15·46	15·33	−1 0·13
	c Orionis		5 30 37·33	5	36·01	35·90	−1 0·11
	σ Orionis		5 33 52·93	5	51·51	51·37	−1 0·14
	b Orionis		5 37 26·31	5	24·70	24·53	−1 0·17
	γ Leporis		5 40 35·13	5	34·66	34·48	−1 0·18
	W.B. VIII–486	W.	8 20 59·03	4	57·64	57·36	−1 0·28
	B.A.C. 2868		8 27 16·51	5	15·66	15·34	−1 0·32
	δ Hydræ		8 32 29·71	5	27·63	27·20	−1 0·43
	6 Hydræ		8 35 30·29	5	29·08	28·62	−1 0·46
	B.A.C. 2954		8 38 57·21	5	55·73	55·30	−1 0·43
Feb. 15	υ Orionis	W.	5 27 19·01	5	17·57	15·31	−1 2·26
	c Orionis		5 30 39·69	5	38·12	35·88	−1 2·24
	σ Orionis		5 33 55·27	5	53·59	51·35	−1 2·24
	b Orionis		5 37 28·77	5	26·89	24·51	−1 2·38
	γ Leporis		5 40 37·41	5	36·76	34·46	−1 2·30
	W.B. VIII–486	E.	8 21 0·99	5	59·92	57·36	−1 2·56
	B.A.C. 2868		8 27 18·55	5	18·00	15·34	−1 2·66
	δ Hydræ		8 32 31·65	5	29·87	27·19	−1 2·68
	6 Hydræ		8 35 32·17	5	31·25	28·61	−1 2·64
	B.A.C. 2954		8 38 59·17	5	57·99	55·30	−1 2·69
Feb. 17	7 Monocerotis	W.	6 15 11·43	5	10·18	3·86	−1 6·32
	8 Monocerotis		6 18 41·43	5	39·50	33·19	−1 6·31
	15 Monocerotis		6 35 39·77	5	37·55	31·18	−1 6·37
	18 Monocerotis		6 42 53·05	5	51·23	44·81	−1 6·42
	B.A.C. 2433	E.	7 17 10·39	5	9·03	2·66	−1 6·37
	ε Canis Minoris		7 20 22·89	5	21·06	14·43	−1 6·63
	B.A.C. 2470		7 23 28·53	5	27·79	21·17	−1 6·62
	o Puppis		7 44 19·72	5	19·81	13·30	−1 6·51
	9 Argûs		7 47 28·07	5	27·44	20·86	−1 6·58
May 22	12 Virginis	E.	12 8 35·55	5	35·29	28·06	−1 7·23
	Lalande 23006		12 12 8·17	5	8·44	1·07	−1 7·37
	η Virginis		12 15 2·19	5	2·12	54·84	−1 7·28
	6 Corvi		12 18 22·65	5	23·10	15·69	−1 7·41
	θ Virginis	W	13 5 0·95	5	0·33	53·44	−1 6·89
	58 Virginis		13 12 26·67	5	26·19	19·39	−1 6·80
	66 Virginis		13 19 35·21	5	34·60	27·73	−1 6·87
	72 Virginis		13 25 27·01	5	26·44	19·49	−1 6·95
May 27	79 Leonis	E.	11 18 15·77	5	15·86	1·37	−0 14·49
	κ Crateris		11 21 29·45	5	29·61	15·33	−0 14·28
	e Leonis		11 24 33·85	5	33·95	19·60	−0 14·35
	B.A.C. 3925		11 27 4·31	5	4·44	50·14	−0 14·30
	h Virginis	W.	13 27 2·61	5	2·64	48·35	−0 14·29
	95 Virginis		14 0 45·01	5	46·09	31·69	−0 14·40
	96 Virginis		14 3 0·95	5	1·03	46·71	−0 14·32
	κ Virginis		14 6 53·71	5	53·79	39·44	−0 14·35
	ι Virginis		14 10 7·29	5	7·34	52·92	−0 14·42
	λ Virginis		14 13 1·25	5	1·36	46·90	−0 14·46

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Time of Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
July 10	32 Libræ - - -	W.	15 22 58·07	5	58·32	39·77	−1 18·55
	ζ^3 Libræ - - -		15 25 22·81	5	23·06	4·67	−1 18·39
	41 Libræ - - -		15 33 29·03	5	29·28	10·82	−1 18·46
	κ Libræ - - -		15 36 30·91	5	31·16	12·71	−1 18·45
	51 Libræ - - -	E.	15 59 14·75	5	15·32	56·49	−1 18·83
	18 Scorpii - - -		16 10 34·49	5	35·07	16·14	−1 18·93
	Lalande 29689 - -		16 13 42·93	5	43·47	24·56	−1 18·91
	ϕ Ophiuchi - - -		16 25 45·45	5	45·99	27·06	−1 18·93
	B.A.C. 6367 - - -	E.	18 38 28·20	4	28·62	9·76	−1 18·86
	B.A.C. 6388 -		18 42 17·43	5	17·85	58·83	−1 19·02
	30 Sagittarii - - -		18 45 8·09	5	8·43	49·32	−1 19·11
	B.A.C. 6488 - - -		18 56 11·57	5	11·88	53·11	−1 18·77
	15 Aquilæ - - -		19 0 6·41	5	6·76	47·82	−1 18·94
	51 Aquilæ - - -	W.	19 45 38·95	5	40·03	21·29	−1 18·74
	β Aquilæ - - -		19 50 53·37	5	53·45	34·82	−1 18·63
	Lalande 38458 - -		20 3 10·87	5	10·98	52·46	−1 18·52
July 13	32 Libræ - - -	W.	15 23 2·13	5	2·25	39·75	−1 22·50
	ζ^3 Libræ - - -		15 25 26·93	5	27·05	4·64	−1 22·41
	37 Libræ - - -		15 29 9·45	5	9·56	47·23	−1 22·33
	41 Libræ - - -		15 33 33·05	5	33·17	10·79	−1 22·38
	48 Libræ - - -	E.	15 53 0·89	5	1·10	38·60	−1 22·50
	50 Libræ - - -		15 55 51·27	5	51·48	29·05	−1 22·43
	51 Libræ - - -		15 59 18·77	5	18·98	56·47	−1 22·51
	18 Scorpii - - -		16 10 38·41	5	38·59	16·12	−1 22·47
	B.A.C. 6279 - - -	E.	18 23 54·97	5	55·14	32·52	−1 22·62
	B.A.C. 6367 - - -		18 38 32·25	5	32·39	9·78	−1 22·61
	B.A.C. 6388 - - -		18 42 21·35	5	21·48	58·85	−1 22·63
	γ^1 Sagittarii - - -		18 48 29·69	5	29·82	7·15	−1 22·67
	B.A.C. 6488 - - -		18 56 15·67	5	15·78	53·13	−1 22·65
	ν Aquilæ - - -	W.	19 21 55·47	5	55·43	32·87	−1 22·56
	e Aquilæ - - -		19 25 56·03	5	56·01	33·54	−1 22·47
	51 Aquilæ - - -		19 45 43·91	5	43·96	21·33	−1 22·63
	η Aquilæ - - -		19 47 54·04	4	54·06	31·61	−1 22·45
1883.							
Jan. 20	Stone 2268 - - -	E.	5 7 18·09	5	18·11	15·33	−1 2·78
	Stone 2335 - - -		5 14 20·23	5	20·39	17·72	−1 2·67
	Stone 2515 - - -	W.	5 33 43·58	5	43·85	41·12	−1 2·73
	Stone 2562 - - -		5 38 14·40	5	14·59	12·13	−1 2·46
	Stone 2622 - - -		5 45 7·82	5	8·01	5·40	−1 2·61
Jan. 22	Stone 2031 - - -	E.	4 39 11·21	5	11·00	4·07	−1 6·93
	Stone 2081 - - -		4 44 24·42	5	24·37	17·40	−1 6·97
	Stone 2113 - - -		4 47 36·55	5	36·32	29·36	−1 6·96
	Stone 2145 - - -		4 51 51·64	5	51·67	44·80	−1 6·87
	Stone 2772 - - -	W.	6 1 8·40	5	8·35	1·27	−1 7·08
	Stone 2806 - - -		6 4 6·12	5	5·87	59·00	−1 6·87
	Stone 2839 - - -		6 7 30·27	5	30·17	23·13	−1 7·04
	Stone 2880 - - -		6 12 35·92	5	35·92	28·98	−1 6·94

Digitized by Google

SECTION V.—TABLE 5.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.		Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.				Lamp W.	Lamp E.
1881.	rev.	rev.	s	s	1881.	rev.	rev.	s	s
April 9	10·512	10·500	−0·062	+0·028	June 20	10·535 10·540	10·500	−0·158	+0·123
April 12	10·512	10·500	−0·062	+0·028					
April 14	10·519	10·500	−0·088	+0·054	June 21	10·538 10·540	10·500	−0·163	+0·129
April 20	10·523	10·500	−0·103	+0·069					
April 22	10·524	10·500	−0·107	+0·073	June 22	10·548 10·544	10·500	−0·189	+0·155
April 28	10·512	10·500	−0·062	+0·028	June 27	10·543 10·543	10·500	−0·178	+0·144
May 12	10·532	10·500	−0·137	+0·103					
May 20	10·531	10·500	−0·133	+0·099	July 12	10·560	10·500	−0·242	+0·208
May 23	10·528	10·500	−0·122	+0·088	1882.				
June 16	10·529 10·538	10·500	−0·144	+0·110	Feb. 13	10·527 10·526 10·529	10·500	−0·118	+0·084
June 17	10·537 10·537	10·500	−0·156	+0·122	Feb. 17	10·539 10·531	10·500	−0·148	+0·114

SECTION V.—TABLE 6.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s	1881.		d	s
April 9	W.	+ 1·03	+0·089	May 20	W.	+ 9·07	+0·827
	E.	+ 1·65	+0·118		W.	+ 9·94	
	E.	+ 1·13			E.	+ 9·44	+0·813
April 12	E.	+ 1·95	+0·166		E.	+ 9·24	
	E.	+ 2·14	+0·182	May 23	E.	− 5·54	−0·450
April 13	E.	+ 3·48	+0·289		E.	− 4·82	
	E.	+ 3·18			W.	− 5·09	−0·443
	W.	+ 3·20	+0·278				
April 14	W.	+ 2·86	+0·275	June 16	E.	− 8·90	−0·789
	W.	+ 3·61			E.	− 9·24	
	E.	+ 4·11	+0·357		W.	−10·22	−0·878
April 20	E.	+ 7·82	+0·682		W.	− 9·94	
	E.	+ 7·85			W.	− 9·19	−0·747
	W.	+ 8·60	+0·774		W.	− 7·99	
	W.	+ 9·20			E.	− 7·62	−0·668
April 22	W.	− 2·70	−0·232		E.	− 7·75	
	W.	− 2·64		June 17	E.	− 8·38	−0·745
	E.	− 2·47	−0·233		E.	− 8·71	
	E.	− 2·88			W.	− 9·50	−0·823
April 28	E.	+ 0·26	+0·022		W.	− 9·44	
May 12	E.	− 0·68	−0·057		W.	− 8·53	−0·736
	W.	− 1·16	−0·094		W.	− 8·39	
	W.	− 1·08			E.	− 7·29	−0·636
	W.	− 1·08	−0·091		E.	− 7·80	

Digitized by Google

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		d	s	1881.		d	s
June 20	E.	−13·45	−1·146	June 27	W.	− 3·41	−0·298
	E.	−12·90			W.	− 3·44	
	W.	−13·56	−1·180		E.	− 2·45	−0·213
	W.	−13·31	−1·148		E.	− 3·04	−0·264*
	W.	−13·18			E.	− 3·49	−0·303
	E.	−13·39	−1·185		E.	− 4·08	−0·354*
	E.	−13·85			W.	− 4·74	−0·410
				July 12	W.	+ 0·04	+0·003
		Level altered.			E.	− 2·01	−0·163
June 21	E.	+ 0·45	+0·038		E.	− 1·73	
	E.	− 0·13	−0·011*	July 13	W.	− 2·26	−0·197
	W.	+ 0·63	+0·055		W.	− 1·68	−0·146*
	W.	+ 1·75	+0·152*	July 28	W.	− 3·86	−0·328
	W.	+ 1·51	+0·125		E.	− 0·73	−0·062
	W.	+ 1·36		1882.			
	E.	+ 1·44	+0·128	February 13	W.	+ 0·39	+0·034
	E.	+ 1·51			W.	+ 1·10	+0·096*
					E.	+ 0·66	+0·057
				February 14	E.	+ 1·16	+0·101
					W.	+ 0·93	+0·104
June 22	E.	− 0·09	−0·012		W.	+ 1·44	
	E.	− 0·18		February 15	W.	+ 2·98	+0·259
	W.	+ 1·24	+0·108		E.	+ 2·76	+0·228
	W.	+ 2·04	+0·177*		E.	+ 2·48	
	W.	+ 3·33	+0·290	February 17	W.	+ 5·15	+0·464
	W.	+ 3·31			W.	+ 5·51	
	E.	+ 2·69	+0·234		E.	+ 4·91	+0·427
	E.	+ 1·55	+0·135*				

SECTION V.—TABLE 7.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
April 9	W.	Lacaille 9123 S.P. -	10 31 10·35	10 30 31·75	−0·790
April 13	E.	Lacaille 8798 S.P. -	9 33 8·94	9 32 30·65	−0·148
	W.	Lacaille 4578 - -	10 47 47·35	10 47 14·72	−0·361
April 14	W.	Lacaille 8798 S.P. -	9 33 9·24	9 32 30·83	−0·190
		Lacaille 4169 - -	9 48 18·80	9 47 43·72	
	E.	Lacaille 248 S.P. -	12 40 10·65	12 39 28·35	−0·373
		ι Octantis - -	12 43 28·84	12 42 54·59	
May 12	E.	Lacaille 248 S.P. -	12 39 55·25	12 39 31·87	+0·888
		ι Octantis - -	12 43 35·26	12 42 52·71	
	W.	κ Octantis - -	13 23 3·68	13 22 17·26	+1·243
		Lacaille 634 S.P. -	13 44 28·09	13 44 6·61	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
May 20	W.	Lacaille 9464 S.P. -	11 27 51·36	11 27 34·15	+0·971
		Lacaille 4865 - -	11 35 31·87	11 34 50·13	
	E.	Lacaille 248 S.P. -	12 39 53·91	12 39 33·52	+0·997
		ι Octantis - - -	12 43 33·67	12 42 51·76	
May 23	E.	Lacaille 4991 - -	11 57 4·34	11 56 35·40	−0·361
		Lacaille 9745 S.P. -	12 2 49·93	12 2 12·40	
	W.	z Octantis - - -	14 32 45·03	14 32 16·92	−0·178
		Lacaille 1029 S.P. -	14 38 40·48	14 38 6·51	
June 16	E.	Lacaille 235 S.P. -	12 44 52·58	12 44 27·13	−0·612
		κ Octantis - - -	13 22 29·91	13 22 12·46	
	W.	Lacaille 634 S.P. -	13 44 42·01	13 44 11·53	−0·686
	W.	σ Octantis - - -	18 29 11·04	18 29 35·21	−0·747
		Lacaille 3274 S.P. -	19 28 12·56	19 27 36·71	
	E.	Lacaille 3238 S.P. -	19 57 14·51	19 56 48·72	−0·638
		Lacaille 8257 - -	20 14 38·23	20 14 21·71	
June 17	E.	κ Octantis - - -	13 22 27·95	13 22 12·19	−0·736
		Lacaille 505 S.P. -	13 33 15·40	13 32 49·22	
	W.	Lacaille 634 S.P. -	13 44 42·93	13 44 11·73	−0·808
		z Octantis - - -	14 32 18·56	14 32 12·06	
	W.	Lacaille 7088 - -	17 9 50·36	17 9 31·78	−0·868
		Lacaille 2138 S.P. -	17 46 55·13	17 46 27·80	
	E.	σ Octantis - - -	18 28 59·28	18 29 28·82	−0·816
June 20	E.	κ Octantis - - -	13 22 18·94	13 22 11·70	−1·652
		Lacaille 634 S.P. -	13 44 52·75	13 44 12·35	
	W.	z Octantis - - -	14 32 2·52	14 32 11·16	−1·585
	W.	Lacaille 1752 S.P. -	16 58 57·50	16 58 30·39	−1·476
		Lacaille 7088 - -	17 9 46·82	17 9 31·83	
	E.	Brisbane 6058 - -	17 45 38·87	17 45 49·24	−1·659
		Lacaille 2296 S.P. -	17 53 29·94	17 52 51·80	
		σ Octantis - - -	18 28 4·51	18 29 30·12	
June 21	E.	κ Octantis - - -	13 22 14·24	13 22 11·51	−2·097
		Lacaille 505 S.P. -	13 33 22·03	13 32 49·61	
	W.	Lacaille 709 S.P. -	14 10 50·54	14 10 18·78	−2·125
		z Octantis - - -	14 31 51·60	14 32 10·85	
	W.	Lacaille 3274 S.P. -	19 28 32·48	19 27 35·63	−2·216
		Lacaille 8094 - -	19 34 29·25	19 34 18·19	
	E.	A Octantis S P. - -	20 6 50·79	20 5 16·48	−2·187
		Lacaille 8360 - -	20 18 31·55	20 18 20·22	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881.					
June 22	E.	κ Octantis - - -	13 22 12·29	13 22 11·31	−2·255
		Lacaille 505 S.P. -	13 33 22·65	13 32 49·71	
	W.	Lacaille 709 S.P. -	14 10 51·36	14 10 18·85	−2·336
		z Octantis - - -	14 31 46·97	14 32 10·53	
	W.	Lacaille 7088 - -	17 9 43·43	17 9 31·85	−2·313
		Lacaille 2066 S.P. -	17 25 58·70	17 25 17·12	
	E.	Lacaille 7348 - -	17 55 29·61	17 55 25·07	- 2·235
		Lacaille 2210 S.P. -	17 58 41·68	17 58 8·29	
June 27	W.	Lacaille 505 S.P. -	13 33 34·68	13 32 50·23	−5·100
		Lacaille 5633 - -	13 40 37·60	13 40 45·58	
	E.	z Octantis - - -	14 30 47·39	14 32 8·87	−5·114
		Lacaille 1029 S.P. -	14 39 39·39	14 38 11·84	
1882.					
Feb. 13	W.	Brisbane 6058 S.P. -	5 47 24·59	5 45 21·72	−3·144
		Lacaille 2296 - -	5 53 37·88	5 53 7·61	
	E.	Λ Octantis - - -	8 5 40·55	8 6 23·20	−3·159
		Lacaille 8257 S.P. -	8 15 34·15	8 14 6·02	
Feb. 14	E.	σ Octantis S.P. - -	6 32 7·03	6 27 43·80	−3·087
		ζ Mensæ - - -	6 50 41·68	6 49 54·70	
	W.	Lacaille 3274 - -	7 28 23·73	7 28 6·32	−2·956
		Lacaille 8094 S.P. -	7 35 27·60	7 34 9·11	
Feb. 15	W.	σ Octantis S.P. - -	6 32 11·74	6 27 45·68	−3·111
		ζ Mensæ - - -	6 50 42·72	6 49 54·58	
	E.	Lacaille 3274 - -	7 28 22·78	7 28 6·02	−3·171
		Lacaille 8094 S.P. -	7 35 31·52	7 34 9·24	
Feb. 17	W.	Brisbane 6058 S.P. -	5 47 40·86	5 45 24·08	−3·420
		Lacaille 2296 - -	5 53 42·65	5 53 6·59	
	E.	Λ Octantis - - -	8 5 37·98	8 6 20·72	−3·433
		Lacaille 8257 S.P. -	8 15 46·03	8 14 6·62	

Digitized by Google

SECTION V.—TABLE 8.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. MACLEAR.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
April 9	36 Sextantis	W.	10 39 36·15	5	35·70	4·28	−31·42
	l Leonis		10 43 34·99	5	34·44	2·98	−31·46
	p^1 Leonis		10 56 20·19	5	19·80	48·26	−31·54
	χ Leonis		10 59 27·45	5	26·94	55·54	−31·40
	A^1 Virginis	E.	11 42 23·03	5	22·56	51·03	−31·53
	η Crateris		11 50 31·75	5	31·63	0·13	−31·50
	Lalande 22585		11 55 12·87	5	12·65	41·05	−31·60
	B.A.C. 4077		12 0 28·89	5	28·57	57·23	−31·34
April 13	13 Sextantis	E.	9 58 37·95	5	38·12	1·11	−37·01
	λ Hydræ		10 5 26·69	5	26·93	49·76	−37·17
	21 Sextantis		10 8 52·35	5	52·57	15·17	−37·40
	22 Sextantis		10 12 22·69	5	22·91	45·66	−37·25
	l Leonis	W.	10 43 40·03	5	39·91	2·94	−36·97
	p^1 Leonis		10 56 25·05	4	25·04	48·24	−36·80
	χ Leonis		10 59 32·47	5	32·37	55·51	−36·86
April 14	Lalande 19241	W.	9 42 57·37	5	57·45	20·42	−37·03
	13 Sextantis		9 58 38·25	5	38·27	1·10	−37·17
	λ Hydræ		10 5 26·67	5	26·78	49·74	−37·04
	21 Sextantis		10 8 52·29	5	52·37	15·16	−37·21
	22 Sextantis		10 12 22·65	5	22·73	45·65	−37·08
	6 Corvi	E.	12 17 49·99	5	50·38	12·80	−37·58
	B.A.C. 4200		12 22 25·39	5	25·58	48·29	−37·29
	Piazzi XII–111		12 26 11·81	5	12·01	34·67	−37·34
May 12	6 Corvi	E.	12 17 47·63	5	47·86	12·68	−35·18
	B.A.C. 4200		12 22 22·79	5	23·30	48·19	−35·11
	Piazzi XII–111		12 26 9·21	5	9·71	34·58	−35·13
	B.A.C. 4238		12 29 5·05	5	5·72	30·61	−35·11
	m Virginis	W.	13 35 59·93	5	0·25	25·33	−34·92
	86 Virginis		13 40 13·95	5	14·20	39·25	−34·95
	47 Hydræ		13 52 28·99	5	28·97	54·23	−34·74
	τ Virginis		13 56 13·07	5	13·58	38·69	−34·89
May 20	A^1 Virginis	W.	11 42 23·43	5	24·58	50·73	−33·85
	η Crateris		11 50 32·67	5	33·65	59·87	−33·78
	Lalande 22585		11 55 13·59	5	14·62	40·81	−33·81
	B.A.C. 4077		12 0 29·71	5	30·80	57·00	−33·80
	44 Virginis	E.	12 54 7·27	5	8·58	34·80	−33·78
	Lalande 24277		12 57 59·81	5	1·01	27·02	−33·99
	θ Virginis		13 4 22·87	5	24·17	50·45	−33·72
May 23	Lalande 23006	E.	12 11 31·26	3	30·84	58·04	−32·80
	η Virginis		12 14 25·03	5	24·55	51·89	−32·66
	B.A.C. 4200		12 22 21·35	5	20·87	48·11	−32·76
	12 Libræ	W.	14 48 2·87	3	2·20	29·40	−32·80
	δ Libræ		14 55 13·83	5	13·20	40·44	−32·76
	110 Virginis		14 57 30·05	5	29·44	56·71	−32·73
	ν Libræ		15 0 36·33	5	35·68	3·10	−32·58

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 16	ψ Virginis	E.	12 48 36·89	5	36·02	12·82	−23·20
	44 Virginis		12 53 58·69	5	57·81	34·60	−23·21
	B.A.C. 4382		13 0 37·38	4	36·51	13·29	−23·22
	θ Virginis		13 4 14·39	5	13·51	50·27	−23·24
	p Virginis	W.	13 49 3·16	3	1·92	38·65	−23·27
	τ Virginis		13 56 2·93	5	1·68	38·59	−23·09
	λ Virginis		14 13 7·95	5	6·71	43·69	−23·02
	υ^2 Virginis		14 16 18·07	5	16·82	53·91	−22·91
	B.A.C. 5890	W.	17 20 47·15	5	45·99	22·95	−23·04
	51 Ophiuchi		17 24 37·75	5	36·64	13·69	−22·95
	57 Ophiuchi		17 31 50·81	5	49·65	26·58	−23·07
	o Serpentis		17 35 11·71	5	10·56	47·64	−22·92
	ν Aquilæ		19 20 53·87	5	52·69	29·55	−23·14
	η Aquilæ	E.	19 46 52·29	5	51·49	28·24	−23·25
	β Aquilæ		19 49 55·65	5	54·84	31·58	−23·26
	Lalande 38458		20 2 12·89	5	12·11	48·93	−23·18
	ξ Capricorni		20 6 15·51	5	14·75	51·80	−22·95
June 17	θ Virginis	E.	13 4 14·33	5	13·44	50·26	−23·18
	54 Virginis		13 7 32·53	4	31·70	8·31	−23·39
	58 Virginis		13 11 40·19	5	39·32	16·17	−23·15
	B.A.C. 4462		13 15 0·23	5	59·30	36·09	−23·21
	τ Virginis	W.	13 56 2·98	4	1·68	38·58	−23·10
	κ Virginis		14 7 0·53	5	59·27	36·26	−23·01
	λ Virginis		14 13 7·90	3	6·65	43·68	−22·97
	υ^2 Virginis		14 16 18·23	5	16·95	53·90	−23·05
	Lalande 31210	W.	17 4 31·57	5	30·39	7·29	−23·10
	37 Ophiuchi		17 7 19·27	5	17·96	54·85	−23·11
	B.A.C. 5890		17 20 47·11	5	45·88	22·96	−22·92
	51 Ophiuchi		17 24 37·83	5	36·70	13·70	−23·00
	Rumker 6386	E.	18 13 52·20	3	51·28	27·98	−23·30
	21 Sagittarii		18 18 44·03	5	43·28	20·03	−23·25
	B.A.C. 6388		18 41 19·65	5	18·79	55·52	−23·27
	30 Sagittarii		18 44 9·53	5	8·79	45·57	−23·22
June 20	58 Virginis	E.	13 11 40·43	5	38·81	16·14	−22·67
	m Virginis		13 35 49·55	5	47·90	25·16	−22·74
	86 Virginis		13 40 3·37	3	1·79	39·09	−22·70
	p Virginis		13 49 3·09	5	1·35	38·62	−22·73
	ι Virginis	W.	14 10 14·31	5	12·35	49·78	−22·57
	λ Virginis		14 13 8·36	4	6·48	43·66	−22·82
	υ Virginis		14 16 18·69	5	16·69	53·88	−22·81
	φ Virginis		14 22 32·33	5	30·33	7·57	−22·76
	Lalande 30831	W.	16 52 24·19	5	22·41	59·62	−22·79
	30 Ophiuchi		16 55 15·61	5	13·71	50·97	−22·74
	40 Ophiuchi		17 14 21·21	5	19·49	56·69	−22·80
	Lalande 31606		17 18 3·87	5	2·14	39·45	−22·69
	B.A.C. 6111	E.	17 58 21·43	5	19·98	57·05	−22·93
	Lalande 33262		18 2 5·19	5	3·30	40·62	−22·68
	μ Sagittarii		18 7 7·19	3	5·68	43·12	−22·56
	Lalande 33596		18 10 34·85	4	33·03	10·20	−22·83
	Rumker 6386		18 13 52·59	5	50·71	28·01	−22·70

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 21	54 Virginis - -	E.	13 7 31·33	5	30·90	8·27	−22·63
	58 Virginis - -		13 11 39·45	5	38·75	16·13	−22·62
	B.A.C. 4462 - -		13 14 59·83	5	58·64	36·05	−22·59
	66 Virginis - -		13 18 48·03	5	47·15	24·52	−22·63
	h Virginis - -		13 27 8·39	5	7·73	45·12	−22·61
	m Virginis - -		13 35 48·45	5	47·66	25·15	−22·51
	κ Virginis - -	W.	14 6 59·69	5	58·71	36·24	−22·47
	υ^2 Virginis - -		14 16 17·63	5	16·40	53·88	−22·52
	B.A.C. 4773 - -		14 18 43·31	4	41·84	19·20	−22·64
	ϕ Virginis - -		14 22 31·35	5	30·14	7·58	−22·56
	ν Aquilæ - - -	W.	19 20 53·44	4	52·15	29·64	−22·51
	e Aquilæ - - -		19 24 54·05	5	52·86	30·24	−22·62
	47 Aquilæ - - -		19 37 25·79	5	24·11	1·65	−22·46
	υ Aquilæ - - -		19 40 20·38	3	18·84	56·23	−22·61
	51 Aquilæ - - -		19 44 41·33	5	40·41	17·82	−22·59
	α^2 Capricorni - -	E.	20 11 54·09	5	53·54	30·91	−22·63
	ρ Capricorni - -		20 22 31·31	5	30·95	8·19	−22·76
	Washington 8892 -		20 24 51·09	5	50·63	28·04	−22·59
	ϵ Delphini - -		20 27 58·97	5	57·62	35·10	−22·52
June 22	66 Virginis -	E.	13 18 47·83	5	46·87	24·52	−22·35
	72 Virginis - -		13 24 39·51	3	38·59	16·27	−22·32
	h Virginis - -		13 27 8·25	5	7·45	45·11	−22·34
	m Virginis - -		13 35 48·21	5	47·36	25·14	−22·22
	κ Virginis - -	W.	14 6 59·53	5	58·48	36·23	−22·25
	λ Virginis - -		14 13 6·96	3	6·03	43·65	−22·38
	υ^2 Virginis - -		14 16 17·57	5	16·23	53·87	−22·36
	B.A.C. 4773 - -		14 18 43·01	4	41·41	19·19	−22·22
	ϕ Virginis - -		14 22 31·17	5	29·86	7·56	−22·30
	37 Ophiuchi - -	W.	17 7 18·91	5	17·28	54·87	−22·41
	Lalande 31606 - -		17 18 2·23	5	1·75	39·47	−22·28
	B.A.C. 5890 - -		17 20 46·33	3	45·27	23·00	−22·27
	51 Ophiuchi - -		17 24 36·59	5	36·25	13·75	−22·50
	Lalande 33262 - -	E.	18 2 4·31	5	3·08	40·64	−22·44
	μ^1 Sagittarii - -		18 7 5·75	5	5·56	43·14	−22·42
	Lalande 33596 - -		18 10 33·67	5	32·64	10·22	−22·42
	Rumker 6386 - -		18 13 51·61	5	50·41	28·04	−22·37
June 27	72 Virginis - -	W.	13 24 39·17	5	36·31	16·23	−20·08
	h Virginis - -		13 27 7·77	5	5·17	45·06	−20·11
	89 Virginis - -		13 43 49·66	4	47·67	27·64	−20·03
	p Virginis - -		13 49 1·69	5	58·48	38·57	−19·91
	υ^2 Virginis - -	E.	14 16 16·71	5	13·91	53·83	−20·08
	B.A.C. 4773 - -		14 18 42·65	5	39·30	19·16	−20·14
	ϕ Virginis - -		14 22 30·39	5	27·60	7·53	−20·07
	Lalande 26492 - -		14 25 14·65	5	11·35	51·24	−20·11
1882.							
Feb. 13	υ Orionis - - -	W.	5 27 14·64	3	13·15	15·34	−57·81
	ι Orionis - - -		5 30 35·11	5	33·56	35·91	−57·65
	σ Orionis - - -		5 33 50·67	3	48·97	51·38	−57·59
	b Orionis - - -		5 37 24·19	5	22·30	24·54	−57·76
	γ Leporis - - -		5 40 32·89	5	32·15	34·50	−57·65
	W.B. VIII–486 -	E.	8 20 56·75	4	55·52	57·36	−58·16
	B.A.C. 2868 - -		8 27 14·25	5	13·55	15·35	−58·20
	δ Hydræ - - -		8 32 27·17	5	25·25	27·20	−58·05
	6 Hydræ - - -		8 35 27·81	5	26·75	28·62	−58·13
	B.A.C. 2954 - -		8 38 54·75	5	53·43	55·30	−58·13

Digitized by Google

Date.	Name of Star.	Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
Feb. 14	7 Monocerotis - -	E.	6 15 5·29	5	4·08	3·90	−1 0·18
	8 Monocerotis - -		6 18 35·17	5	33·39	33·22	−1 0·17
	15 Monocerotis - -		6 35 33·45	5	31·42	31·21	−1 0·21
	18 Monocerotis - -		6 42 46·77	5	45·08	44·84	−1 0·24
	ϵ Canis Minoris - -	W.	7 20 16·97	5	14·88	14·45	−1 0·43
	B.A.C. 2470 - -		7 23 23·05	5	21·88	21·19	−1 0·69
	o Puppis - - -		7 44 14·24	5	13·75	13·33	−1 0·42
	9 Argûs - - -		7 47 22·39	5	21·32	20·88	−1 0·44
Feb. 15	7 Monocerotis - -	W.	6 15 7·55	5	6·24	3·89	−1 2·35
	8 Monocerotis - -		6 18 37·49	5	35·59	33·21	−1 2·38
	15 Monocerotis - -		6 35 35·73	5	33·57	31·20	−1 2·37
	18 Monocerotis - -		6 42 48·99	5	47·19	44·83	−1 2·36
	B.A.C. 2433 - -	E.	7 17 6·45	5	4·96	2·68	−1 2·28
	ϵ Canis Minoris - -		7 20 18·77	5	16·84	14·44	−1 2·40
	B.A.C. 2470 - -		7 23 24·49	5	23·56	21·18	−1 2·38
	o Puppis - - -		7 44 15·84	5	15·70	13·32	−1 2·38
	9 Argûs - - -		7 47 24·13	5	23·33	20·88	−1 2·45
Feb. 17	υ Orionis - - -	W.	5 27 22·81	5	21·54	15·28	−1 6·26
	c Orionis - - -		5 30 43·47	5	42·06	35·85	−1 6·21
	σ Orionis - - -		5 33 59·13	5	57·61	51·32	−1 6·29
	b Orionis - - -		5 37 32·49	5	30·74	24·48	−1 6·26
	γ Leporis - - -		5 40 41·07	5	40·66	34·43	−1 6·23
	W.B. VIII–486 -	E.	8 21 4·75	5	3·77	57·35	−1 6·42
	δ Hydræ - - -		8 32 35·49	5	33·71	27·19	−1 6·52
	6 Hydræ - - -		8 35 35·85	5	35·07	28·61	−1 6·46
	B.A.C. 2954 - -		8 39 2·81	5	1·73	55·30	−1 6·43

SECTION V.—TABLE 9.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.		Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.				Lamp W.	Lamp E.
1882.	rev.	rev.	s	s	1883.	rev.	rev.	s	s
May 22	10·563	10·500	−0·255	+0·221	Jan. 10	10·651	10·627	−0·107	+0·073
					Jan. 12	10·657	10·627	−0·126	+0·092
May 27	10·550	10·550	−0·017	−0·017	Jan. 20	10·663	10·650	−0·066	+0·032

Digitized by Google

SECTION V.—TABLE 10.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		d	s	1883.		d	s
May 22	E.	+ 5·14	+0·447	Jan. 12	W.	− 1·49	−0·130
	E.	+ 4·46	+0·389*		W.	− 0·80	−0·070*
	W.	+ 6·45	+0·561		W.	− 1·00	−0·087
					E.	− 0·48	−0·042
May 27	E.	+ 1·55	+0·132		E.	− 1·71	−0·149*
	W.	+ 1·91			E.	− 2·85	−0·248*
	W.	+ 2·23	+0·176				
				Jan. 20	E.	+ 0·88	
1883.					E.	+ 0·65	+0·066
					W.	+ 3·39	+0·295
Jan. 10	E.	− 2·99	−0·260				
	E.	− 4·04	−0·351*				
	E.	− 4·04	−0·351	Jan. 22	E.	− 1·73	−0·150
	W.	− 3·14	−0·273		W.	− 0·13	−0·011
	W.	− 2·89	−0·251		W.	0·00	0·000
	W.	− 1·53	−0·133				

SECTION V.—TABLE 11.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Position of Lamp.	Name of Star.	Observed Transit corrected for Collimation and Level.	Tabular Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
May 22	E.	τ Octantis S.P. - -	11 11 7·57	11 9 31·05	− 1·142
		Lacaille 4865 - -	11 35 50·50	11 34 53·35	
	W.	Lacaille 634 S.P. -	13 45 22·76	13 44 1·37	− 1·368
		Lacaille 5802 - -	14 9 25·67	14 8 27·68	
May 27	E.	Lacaille 4991 - -	11 56 51·15	11 56 39·58	− 0·233
		Lacaille 9745 S.P. -	12 2 30·03	12 2 12·91	
	W.	Lacaille 248 S.P. -	12 39 51·53	12 39 31·59	− 0·411
		ι Octantis - - -	12 43 9·38	12 42 58·30	
1883.					
Jan. 10	E.	Lacaille 6727 S.P. -	4 16 3·47	4 15 31·62	+ 2·078
	W.	Lacaille 1752 - -	4 59 23·67	4 58 36·93	+ 2·007
Jan. 12	W.	Lacaille 1222 - -	3 32 24·53	3 31 33·42	+ 1·717
		Lacaille 6727 S.P. -	4 16 9·17	4 15 31·85	
	E.	Lacaille 1752 - -	4 59 27·07	4 58 36·81	+ 1·809
		Lacaille 7088 S.P. -	5 10 8·92	5 9 33·53	
Jan. 20	W.	Lacaille 3238 - -	7 58 5·81	7 56 58·97	+ 0·835

Digitized by Google

SECTION V.—TABLE 12.

OBSERVATIONS WITH THE SMALL TRANSIT AT THE CAPE BY MR. PETT.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	m s
May 22	79 Leonis	E.	11 19 8·79	5	8·67	1·42	−1 7·25
	κ Crateris		11 22 22·39	5	22·57	15·39	−1 7·18
	B.A.C. 3925		11 28 57·31	5	57·37	50·19	−1 7·18
	θ Crateris		11 31 51·35	5	51·46	44·32	−1 7·14
	τ Virginis	W.	13 56 49·31	5	48·64	41·62	−1 7·02
	95 Virginis		14 1 39·39	5	39·00	31·70	−1 7·30
	κ Virginis		14 7 47·01	5	46·65	39·47	−1 7·18
	υ^2 Virginis		14 17 4·75	5	4·20	56·95	−1 7·25
May 27	η Crateris	E.	11 50 17·09	5	17·21	2·80	−0 14·41
	12 Virginis		12 7 42·45	5	42·38	28·01	−0 14·37
	Lalande 23006		12 11 15·27	5	15·34	1·03	−0 14·31
	6 Corvi		12 17 29·91	5	30·01	15·64	−0 14·37
	ψ Virginis	W.	12 48 30·17	5	30·13	16·01	−0 14·12
	44 Virginis		12 53 51·91	5	51·83	37·74	−0 14·09
	Lalande 24277		12 57 44·33	5	44·38	30·11	−0 14·27
	B.A.C. 4382		13 0 30·77	5	30·78	16·53	−0 14·25
1883.							
Jan. 20	Stone 2031	E.	4 39 6·61	5	6·66	4·11	−1 2·55
	Stone 2081		4 44 19·84	5	20·02	17·40	−1 2·62
	Stone 2113		4 47 32·13	4	32·16	29·39	−1 2·77
	Stone 2145		4 51 47·10	5	47·34	44·82	−1 2·52
	Stone 2772	W.	6 1 3·79	2	4·07	1·27	−1 2·80
	Stone 2806		6 4 1·46	5	1·61	59·03	−1 2·58
	Stone 2839		6 7 25·47	5	25·70	23·15	−1 2·55
	Stone 2880		6 12 31·30	5	31·61	29·02	−1 2·59
Jan. 22	Stone 2268	E.	5 7 22·49	5	22·21	15·30	−1 6·91
	Stone 2335		5 10 46·31	5	46·14	39·06	−1 7·08
	Stone 2300		5 14 24·89	5	24·74	17·69	−1 7·05
	Stone 2362		5 18 6·94	5	6·99	0·03	−1 6·98
	Stone 2515	W.	5 33 48·08	5	48·12	41·10	−1 7·02
	Stone 2562		5 38 19·06	5	18·99	12·11	−1 6·88
	Stone 2595		5 42 41·63	5	41·42	34·59	−1 6·83
	Stone 2622		5 45 12·18	5	12·11	5·38	−1 6·73

Digitized by Google

Digitized by Google

SECTION VI.

OBSERVATIONS AT DURBAN.

		Page
TABLE 1.	—Mr. Finlay's Determinations of Collimation Error - - -	56
„ 2.	— „ „ Level Error - - -	56
„ 3.	— „ „ Azimuth Error - - -	57
„ 4.	— „ Transit Observations - - - -	58
„ 5.	—Mr. Maclear's Determinations of Collimation Error - -	60
„ 6.	— „ „ Level Error - - - -	61
„ 7.	— „ „ Azimuth Error - - -	63
„ 8.	— „ Transit Observations - - - - -	66
„ 9.	—Mr. Pett's Determinations of Collimation Error - - -	72
„ 10.	— „ „ Level Error - - -	72
„ 11.	— „ „ Azimuth Error - - -	72
„ 12.	— „ Transit Observations - - - - -	73

Digitized by Google

SECTION VI.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1881.	r	r	s	s
June 16	10·250 10·248	10·300	+0·173	−0·209
17	10·242 10·271	10·300	+0·147	−0·183
18	10·287	10·300	+0·031	−0·067
21	10·330 10·310	10·300	−0·095	+0·055
22	10·305 10·315	10·300	−0·055	+0·019
1881.	r	r	s	s
June 23	10·328	10·300	−0·123	+0·087
24	10·324	10·300	−0·108	+0·072
27	10·335	10·300	−0·149	+0·113
30	10·343 10·326	10·300	−0·145	+0·109
Nov. 25	10·322	10·300	−0·100	+0·064

SECTION VI.—TABLE 2.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Hour.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.	h m		d	s
June 17	8 0	E.	+0·96	+0·065
	9 15	E.	+0·89	
	9 30	W.	+1·19	+0·131
	12 0	W.	+2·10	+0·244
	13 30	W.	+2·71	
	13 30	E.	+1·62	+0·106
	14 30	E.	+1·13	
21	6 0	W.	+0·70	+0·088
	7 0	W.	+0·75	
	9 0	E.	+0·98	+0·071
	10 0	E.	−0·31	−0·049*
	13 30	E.	−1·69	−0·193
	14 15	E.	−2·04	
	14 30	W.	−1·64	−0·132
	15 30	W.	−0·20	+0·002*
22	6 0	E.	+0·85	+0·059
	6 30	E.	−0·48	−0·065*
	8 30	W.	−1·28	−0·089
	9 30	W.	−1·09	
	11 15	W.	−1·88	−0·154
	12 15	W.	−0·21	0·000*
	12 30	E.	−0·18	−0·037*
	13 30	E.	−1·06	−0·119
23	8 45	E.	−0·74	−0·089
	9 45	E.	−2·00	−0·206*
	10 0	W.	−2·84	−0·244
	11 0	W.	−1·60	−0·128*
1881.	h m		d	s
June 24	6 0	W.	−0·24	−0·002
	6 30	W.	−0·25	
	9 30	E.	−0·88	−0·102
	10 30	E.	−1·40	−0·151*
27	7 30	W.	−0·83	−0·057
	8 45	W.	−0·20	+0·001*
	8 45	E.	−0·26	−0·045
	9 30	E.	−0·76	−0·091*
28	10 15	E.	−1·25	−0·152
	11 15	E.	−1·56	
30	8 45	W.	−1·89	−0·155
	9 30	W.	−0·70	−0·045*
Nov. 20	10 30	E.	+0·85	+0·059
	11 30	E.	−0·90	−0·104*
	11 45	W.	−0·95	−0·044
	12 45	W.	−0·45	
21	12 0	W.	−0·52	−0·021
	13 45	W.	−0·36	
	13 45	E.	−0·35	−0·053
	15 0	E.	−1·51	−0·161*
26	11 0	E.	−2·24	−0·229
	13 0	E.	−3·53	−0·349*

Digitized by Google

SECTION VI.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
June 17	E.	z Octantis - -	8 47 48·41	8 47 35·16	−1·392
	W.	Lacaille 6484 - -	9 59 24·92	9 58 47·58	−1·580
		Lacaille 1592 S.P. -	10 20 25·68	10 19 24·23	
	W.	ζ Mensæ S.P. - -	13 5 17·35	13 4 24·74	−1·500
		Lacaille 7751 - -	13 10 31·17	13 10 1·14	
	E.	A Octantis S.P. - -	14 21 22·16	14 19 47·97	−1·436
		Lacaille 8257 - -	14 29 21·06	14 28 49·00	
		Instrument moved in Azimuth.			
June 21	W.	β Hydri S.P. - -	6 20 3·61	6 19 30·99	+0·598
		Brisbane 4091 - -	6 36 49·27	6 35 39·04	
	E.	Lacaille 6484 - -	9 43 42·15	9 43 3·86	+0·594
		Lacaille 1592 S.P. -	10 4 10·12	10 3 40·90	
	E.	Lacaille 3238 S.P. -	13 56 7·81	13 55 34·64	+0·529
		Lacaille 8257 - -	14 13 47·28	14 13 6·08	
	W.	Lacaille 8570 - -	14 49 40·29	14 49 2·48	+0·481
June 22	E.	Lacaille 4991 - -	5 53 23·51	5 52 38·24	+0·655
		Lacaille 9745 S.P. -	5 58 59·69	5 58 30·70	
	W.	Lacaille 6216 - -	9 12 43·27	9 12 2·31	+0·350
		Lacaille 1222 S.P. -	9 27 39·02	9 27 2·41	
	W.	Brisbane 6058 - -	11 41 45·87	11 41 1·24	+0·339
		Lacaille 2296 S.P. -	11 48 36·67	11 48 2·49	
	E.	ζ Mensæ S.P. - -	12 45 20·40	12 44 44·95	+0·379
		Lacaille 7751 - -	12 51 3·35	12 50 22·19	
June 27	W.	z Octantis -	8 8 53·34	8 8 12·87	+0·384
		Lacaille 972 S.P. -	8 27 43·15	8 27 12·15	
	E.	Lacaille 6484 - -	9 20 1·61	9 19 28·20	+0·434
		Lacaille 1414 S.P. -	9 21 38·04	9 21 10·74	
Nov. 20	E.	Lacaille 972 - -	10 51 45·49	10 51 19·55	−8·081
		Lacaille 6216 S.P. -	11 18 5·56	11 16 4·99	
	W.	Lacaille 1592 - -	12 3 49·25	12 4 32·65	−8·564
		Lacaille 6727 S.P. -	12 16 35·98	12 15 5·79	
Nov. 21	W.	Lacaille 1444 - -	12 4 14·64	12 4 0·58	−8·701
		Lacaille 6727 S.P. -	12 12 40·09	12 11 9·90	
	E.	Lacaille 2296 - -	13 48 24·06	13 48 50·29	−8·253
		Lacaille 7751 S.P. -	14 52 39·95	14 50 26·41	
		Instrument moved in Azimuth.			
Nov. 26	E.	Lacaille 1592 - -	11 41 34·78	11 40 56·94	−0·526
		Lacaille 6727 S.P. -	11 52 16·52	11 51 30·47	
Nov. 27	W.	z Octantis S.P. - -	10 5 6·70	10 4 4·69	−0·600
		Lacaille 972 - -	10 24 28·40	10 23 47·96	
		Lacaille 1444 - -	11 41 5·23	11 40 25·06	

Digitized by Google

SECTION VI.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 17	30 Sagittarii	W.	12 59 11·02	5	11·23	27·52	−43·71
	19 Aquilæ		13 18 37·10	5	36·57	52·60	−43·97
	20 Aquilæ		13 21 39·64	5	39·45	55·50	−43·95
	d Sagittarii		13 26 5·94	5	6·05	21·92	−44·13
	v Sagittarii		13 30 19·60	5	19·63	35·54	−44·09
	β Aquilæ	W.	14 4 48·06	5	47·12	2·76	−44·36
	63 Sagittarii		14 10 37·56	5	37·06	52·63	−44·43
	τ Aquilæ		14 13 38·22	5	37·26	52·74	−44·52
	B.A.C. 7014		14 32 32·44	5	31·53	47·00	−44·53
	ρ Capricorni		14 37 18·98	5	18·59	33·90	−44·69
June 21	*ϵ* Corvi	W.	6 4 42·00	5	42·08	6·69	−35·39
	Piazzi XII–111		6 26 9·60	5	9·84	34·51	−35·33
	B.A.C. 4238		6 29 5·04	3	5·38	30·04	−35·34
	ψ Virginis		6 48 44·50	5	44·70	9·32	−35·38
	44 Virginis		6 54 5·40	5	5·65	30·22	−35·43
	κ Libræ	E.	9 35 14·18	5	14·44	38·64	−35·80
	48 Libræ		9 51 37·54	5	37·76	1·96	−35·80
	50 Libræ		9 54 27·54	5	27·81	52·05	−35·76
	51 Libræ		9 57 54·34	5	54·58	18·84	−35·74
	η Aquilæ	E.	13 45 52·20	4	52·36	16·38	−35·98
	β Aquilæ		13 48 55·04	5	55·25	19·21	−36·04
	ξ Capricorni		14 5 12·62	5	12·65	36·76	−35·89
	α^1 Capricorni		14 10 26·94	5	26·97	50·87	−36·10
	η Capricorni	W.	14 56 54·22	5	54·14	18·03	−36·11
	ν Aquarii		15 2 21·88	5	21·87	45·68	−36·17
	α Equulei		15 9 6·14	5	6·28	30·25	−36·03
June 22	6 Corvi	E.	6 13 56·36	5	56·47	18·00	−38·47
	B.A.C. 4200		6 18 31·10	5	31·39	52·81	−38·58
	Piazzi XII–111		6 22 16·58	4	16·86	38·61	−38·26
	χ Virginis		6 29 50·18	5	50·39	12·11	−38·28
	ι^1 Libræ	W.	9 1 46·38	5	46·30	8·36	−37·94
	3 Serpentis		9 5 35·22	5	35·29	57·33	−37·96
	ζ^3 Libræ		9 20 14·60	5	14·54	36·59	−37·95
	37 Libræ		9 23 56·60	5	56·58	18·72	−37·86
	Lalande 33262	W.	11 57 27·36	5	27·47	49·93	−37·54
	μ Sagittarii		12 2 29·30	5	29·25	51·61	−37·64
	Lalande 33596		12 5 55·60	5	55·69	18·12	−37·57
	21 Sagittarii		12 14 4·16	4	4·14	26·67	−37·47
	d Sagittarii	E.	13 6 19·94	4	19·94	42·47	−37·47
	υ Sagittarii		13 10 33·54	5	33·56	56·09	−37·47
	ν Aquilæ		13 16 3·28	5	3·40	26·04	−37·36
	e Aquilæ		13 20 3·26	5	3·36	25·98	−37·38

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
June 27	12 Libræ	W.	8 24 3·10	5	2·85	30·91	−31·94
	δ Libræ		8 31 12·72	5	12·69	40·78	−31·91
	110 Virginis		8 33 28·50	5	28·55	56·66	−31·89
	ν Libræ		8 36 34·58	5	34·51	2·58	−31·93
	37 Libræ	E.	9 4 11·04	5	11·25	39·14	−32·11
	41 Libræ		9 8 33·72	5	33·87	1·78	−32·09
	κ Libræ		9 11 35·14	5	35·27	3·16	−32·11
	48 Libræ		9 27 58·37	3	58·53	26·48	−32·05
Nov. 20	94 Ceti	E.	11 7 38·40	5	34·57	44·75	−49·82
	ζ Eridani		11 10 57·92	5	55·02	5·19	−49·83
	Lalande 6476		11 24 50·44	5	47·99	58·45	−49·54
	τ^5 Eridani		11 29 21·56	4	20·28	30·56	−49·72
	μ Tauri	W.	12 9 51·94	5	46·48	57·16	−49·32
	44 Eridani		12 23 7·12	5	2·63	13·42	−49·21
	45 Eridani		12 26 30·90	5	26·61	37·25	−49·36
	W.B. IV-585		12 29 11·45	4	8·30	19·02	−49·28
Nov. 21	44 Eridani	W.	12 19 10·94	5	6·39	17·52	−48·87
	45 Eridani		12 22 34·54	5	30·19	41·35	−48·84
	Lalande 8935		12 35 6·10	5	2·85	13·92	−48·93
	Lalande 9045		12 38 57·34	5	55·27	6·39	−48·88
	B.A.C. 1994	E.	14 2 34·10	5	30·74	41·47	−49·27
	5 Monocerotis		14 5 32·31	4	28·90	39·75	−49·15
	7 Monocerotis		14 10 26·98	5	23·75	34·63	−49·12
	8 Monocerotis		14 13 57·32	5	52·54	3·26	−49·28
Nov. 26	24 Eridani	E.	11 15 34·12	5	33·66	50·00	−43·66
	30 Eridani		11 23 53·52	5	53·09	9·61	−43·48
	Lalande 7273		11 26 44·38	5	43·99	0·43	−43·56
	Lalande 9293		12 28 26·68	5	26·17	42·78	−43·39
	64 Eridani		12 31 17·28	5	16·81	33·38	−43·43
	ι Orionis		12 38 17·14	5	16·55	33·02	−43·53
	λ Eridani		12 40 19·12	4	18·62	35·09	−43·53
	τ Orionis		12 48 40·32	5	39·80	56·36	−43·44
	o Orionis		12 52 31·44	5	30·88	47·40	−43·48
	Lalande 10145		12 55 23·94	5	23·37	40·02	−43·35
Nov. 27	ρ^3 Eridani	W.	10 31 41·28	5	40·82	58·38	−42·44
	94 Ceti		10 39 56·32	5	55·82	13·40	−42·42
	ζ Eridani		10 43 16·68	5	16·24	33·84	−42·40
	Lacaille 1051		10 46 19·16	5	18·83	36·45	−42·38
	o Tauri		10 51 37·44	5	36·87	54·30	−42·57
	Lalande 6476		10 57 10·00	5	9·59	27·27	−42·32
	τ^5 Eridani		11 1 41·68	5	41·34	59·23	−42·11
	20 Eridani		11 4 1·74	5	1·37	19·16	−42·21
	22 Eridani		11 7 54·22	5	53·75	11·59	−42·16

Digitized by Google

SECTION VI.—TABLE 5.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1881.	rev.	rev.	s	s
Aug. 13	10·326	10·300	−0·115	+0·079
Aug. 14	10·307	10·300	−0·044	+0·008
Aug. 18	10·317	10·300	−0·082	+0·046
Aug. 19	10·333	10·300	−0·141	+0·105
Aug. 23	10·318	10·300	−0·085	+0·049
Aug. 24	10·323	10·300	−0·104	+0·068
Aug. 29	10·326	10·300	−0·115	+0·079
Aug. 30	10·330	10·300	−0·130	+0·094
Sept. 1	10·322	10·300	−0·100	+0·064
Sept. 2	10·339	10·300	−0·164	+0·128
Sept. 9	10·336	10·300	−0·153	+0·117
Sept. 13	10·329	10·300	−0·126	+0·090
Sept. 19	10·315	10·300	−0·074	+0·038
Sept. 23	10·287	10·300	+0·032	−0·066
Sept. 24	10·295	10·300	+0·002	−0·036
Sept. 27	10·316	10·300	−0·078	+0·042
Oct. 11	10·305	10·300	−0·037	+0·001
Oct. 17	10·291	10·300	+0·016	−0·052
Oct. 24	10·289	10·300	+0·023	−0·059
Nov. 4	10·304	10·300	−0·033	−0·003
Nov. 11	10·310	10·300	−0·055	+0·019
Nov. 20	10·307	10·300	−0·044	+0·008
Nov. 21	10·309	10·300	−0·052	+0·016
Nov. 26	10·298	10·300	−0·010	−0·026
Dec. 9	10·302	10·300	−0·025	−0·011
Dec. 23	10·328 10·312	10·300	−0·093	+0·057
Dec. 29	10·302	10·300	−0·025	−0·011
1882.				
Jan. 8	10·315 10·314	10·300	−0·074	+0·038
Jan. 9	10·345	10·300	−0·186	+0·150
Jan. 13	10·377 10·369	10·300 10·300	−0·306 −0·276	+0·270 +0·240
Jan. 14	10·376 10·391	10·300 10·300	−0·302 −0·358	+0·266 +0·322
Jan. 17	10·379	10·300	−0·314	+0·278
Jan. 20	10·371 10·363	10·300	−0·269	+0·233
Jan. 21	10·388 10·358	10 ?	−0·291	+0·255
Jan. 25	10·357	10·300	−0·231	+0·195
Jan. 26	10·374 10·387	10·300	−0·321	+0·285
Jan. 27	10·370 10·368	10·300	−0·276	+0·240

Digitized by Google

SECTION VI.—TABLE 6.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		div.	s
August 18	W.	−1·28	−0·099
	W.	−1·89	−0·156*
	E.	−1·56	−0·166
	E.	−3·75	−0·369*
	E.	−4·49	−0·424
	E.	−4·19	
	W.	−4·03	−0·354
	W.	−2·59	−0·220*
August 19	W.	−0·93	−0·046
	W.	−0·48	
	E.	+0·17	−0·005
	E.	−1·58	−0·167*
	E.	−3·13	−0·298
	E.	−2·86	
	W.	−2·66	−0·220
	W.	−2·51	
August 20	W.	−0·48	−0·024
	W.	−1·03	−0·075*
	E.	−0·86	−0·100
	E.	−1·70	−0·179*
	E.	−3·06	−0·310
	E.	−3·15	
	W.	−3·01	−0·259
	W.	−2·20	−0·184*
August 21	W.	−0·94	−0·063
	W.	−0·83	
	E.	−1·15	−0·127
	E.	−2·44	−0·247*
August 23	W.	−1·30	−0·119
	W.	−1·68	
	E.	−0·93	−0·107
	E.	−2·69	−0·271*
	E.	−4·65	−0·447
	E.	−4·53	
	W.	−4·16	−0·366
	W.	−3·28	−0·285*
August 24	E.	+0·20	−0·002
	E.	−1·09	−0·121*
	W.	−0·94	−0·063
	W.	−0·83	
August 29	E.	−1·20	−0·132
	E.	−1·83	−0·191*
	W.	−2·40	−0·186
	W.	−2·03	
	W.	−2·58	−0·218
	W.	−2·53	
	E.	−2·39	−0·243
	E.	−3·15	−0·313*
September 1	W.	−0·83	−0·057
	E.	−1·20	−0·132
September 2	E.	−1·53	−0·163
	E.	−2·11	−0·217*
	W.	−2·50	−0·212
	W.	−3·20	−0·277*
1881.		div.	s
September 8	W.	−3·31	−0·287
	E.	−3·29	−0·327
September 9	E.	−3·28	−0·326
	W.	−4·20	−0·364
September 13	W.	−1·80	−0·147
	W.	−2·35	−0·198*
	E.	−1·99	−0·206
	E.	−4·40	−0·430
September 17	E.	−2·63	−0·265
	W.	−4·79	−0·426
September 18	W.	−2·68	−0·236
	W.	−2·81	
	E.	−2·49	−0·252
	E.	−3·70	−0·365*
September 19	E.	−3·74	−0·368
	E.	−4·34	−0·424*
	W.	−4·90	−0·435
	W.	−4·89	
	W.	−5·00	−0·444
	W.	−4·05	−0·356*
	E.	−4·63	−0·451
	E.	−5·25	−0·509*
September 20	W.	−4·16	−0·370
	W.	−4·24	
	E.	−3·56	−0·351
September 22	E.	−4·01	−0·401
	E.	−4·16	
	W.	−4·51	−0·392
	W.	−4·36	
	W.	−5·99	−0·528
	W.	−5·79	
	E.	−6·20	−0·612
	E.	−6·53	
September 23	E.	−3·48	−0·344
	E.	−4·66	−0·454*
	W.	−5·04	−0·430
	W.	−4·64	
	W.	−6·20	−0·551
	W.	−6·08	
	E.	−5·23	−0·529
	E.	−5·70	
September 26	W.	−4·66	−0·408
	W.	−4·56	
	E.	−4·39	−0·429
	E.	−5·34	−0·517*
	E.	−6·47	−0·626
	E.	−6·55	
	W.	−7·00	−0·610
	W.	−6·56	

Digitized by Google

Date.	E. or W.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		div.	s
September 27	E.	−4·43	−0·432
	E.	−5·08	−0·493*
	W.	−5·46	−0·488
September 28	W.	−3·64	−0·318
	W.	−4·96	−0·441*
	E.	−4·24	−0·415
	E.	−5·48	−0·530*
October 14	W.	−6·81	−0·613
	E.	−7·49	−0·717
October 16	E.	−5·41	−0·524
	W.	−6·39	−0·574
		Level altered.	
October 17	E.	−2·44	−0·286
	E.	−3·25	
	W.	−3·40	−0·288
	W.	−3·23	
October 18	W.	−2·15	−0·205
	W.	−2·69	
	E.	−2·73	−0·306
	E.	−3·41	
October 19	E.	−2·53	−0·310
	E.	−3·68	
	W.	−3·93	−0·320
	W.	−3·38	
October 21	W.	−1·60	−0·128
	E.	−1·09	−0·122
October 24	W.	−0·86	−0·060
October 25	W.	−0·21	+0·001
October 29	E.	−1·65	−0·174
	W.	−1·70	−0·137
November 8	E.	−2·24	−0·229
	W.	−2·40	−0·202
November 9	W.	−2·78	−0·239
	E.	−2·53	−0·256
November 14	W.	−2·15	−0·180
	E.	−2·14	−0·220
November 15	E.	−2·89	−0·289
	W.	−3·11	−0·268
November 20	E.	+0·16	−0·012
	E.	+0·02	
	W.	−0·29	+0·004
	W.	−0·08	

Date.	E. or W.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1881.		div.	s
November 21	W.	−0·49	−0·016
	W.	−0·31	
	E.	−0·18	−0·037
	E.	−1·20	−0·132*
November 27	W.	−2·16	−0·208
	W.	−2·75	
December 23	W.	−2·79	−0·216
	W.	−2·29	
	E.	−1·79	−0·210
	E.	−2·26	
	E.	−3·83	−0·361
	E.	−3·51	
	W.	−3·98	−0·333
	W.	−3·61	
December 29	W.	−2·74	−0·234
	W.	−3·60	−0·314*
	E.	−2·84	−0·285
	E.	−3·39	−0·336*
1882.			
January 8	W.	−5·44	−0·486
	E.	−5·39	−0·522
January 13	E.	−5·71	−0·559
	E.	−5·86	
	W.	−6·30	−0·545
	W.	−5·86	
January 14	E.	−4·63	−0·451
	E.	−6·55	−0·630*
	W.	−6·45	−0·580
	W.	−6·44	
January 17	E.	−5·75	−0·556
	W.	−6·16	−0·553
January 20	E.	−5·70	−0·551
	W.	−6·46	−0·581
January 21	W.	−4·85	−0·424
	W.	−4·69	
	E.	−4·46	−0·435
	E.	−5·46	−0·528*
January 25	W.	−5·73	−0·513
	E.	−5·33	−0·517
January 26	W.	−6·18	−0·561
	W.	−6·31	
	E.	−6·15	−0·592
	E.	−6·79	−0·652*
January 27	E.	−5·64	−0·545
	E.	−6·70	−0·641*
	W.	−6·64	−0·589
	W.	−6·45	
	W.	−6·80	−0·615
	W.	−6·86	
	E.	−6·60	−0·634
	E.	−7·23	−0·693*

Digitized by Google

SECTION VI.—TABLE 7.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881.					
Aug. 18	W.	Lacaille 1752 S.P. -	7 9 58·75	7 9 46·13	+4·444
		Lacaille 7078 - -	7 36 51·32	7 35 38·66	
	E.	Lacaille 2426 S.P. -	8 31 35·58	8 31 36·05	+4·492
		σ Octantis - - -	8 45 46·55	8 40 10·61	
	E.	β Octantis - - -	11 33 17·62	11 26 48·10	+4·416
		Lacaille 3981 S.P. -	11 38 27·97	11 38 23·76	
	W.	C Octantis - - -	12 20 47·55	12 19 19·25	+4·279
		Lacaille 4510 S.P. -	12 47 31·22	12 47 51·64	
Aug. 19	W.	Lacaille 1752 S.P. -	7 6 1·19	7 5 50·31	+4·571
		Lacaille 7078 - -	7 32 55·18	7 31 42·54	
	E.	σ Octantis - - -	8 41 53·76	8 36 13·76	+4·560
		Lacaille 3274 S.P. -	9 33 43·01	9 34 27·82	
	E.	Lacaille 4169 S.P. -	11 53 23·51	11 53 47·43	+4·493
		C Octantis - - -	12 16 53·52	12 15 23·40	
	W.	Lacaille 4578 S.P. -	12 52 24·32	12 53 1·47	+4·412
		τ Octantis - - -	13 18 49·14	13 16 30·46	
Aug. 20	W.	Lacaille 6817 - -	6 30 24·40	6 29 43·18	+4·465
		Lacaille 1752 S.P. -	7 2 3·99	7 1 54·47	
	E.	Lacaille 7078 - -	7 28 58·48	7 27 46·43	
		Brisbane 6058 - -	7 50 53·49	7 48 51·71	+4·629
		σ Octantis - - -	8 37 56·36	8 32 16·85	
	E.	Lacaille 8570 - -	10 53 52·71	10 53 10·36	+4·595
		ζ Octantis S.P. - -	11 15 35·98	11 15 58·93	
	W.	τ Octantis - - -	13 14 51·79	13 12 34·80	+4·327
		Lacaille 4784 S.P. -	13 25 30·25	13 25 45·65	
Aug. 23	W.	Lacaille 6817 - -	6 18 34·16	6 7 55·21	+4·637
		Lacaille 1839 S.P. -	6 25 4·96	6 25 49·99	
	E.	Lacaille 2138 S.P. -	7 37 52·16	7 37 56·76	+4·650
		σ Octantis - - -	8 26 5·09	8 20 25·88	
	E.	Lacaille 4169 S.P. -	11 37 35·80	11 38 3·81	+4·496
		C Octantis - - -	12 1 6·05	11 59 39·96	
	W.	Lacaille 4510 S.P. -	12 27 42·01	12 28 11·82	
		Lacaille 4578 S.P. -	12 36 37·81	12 37 17·53	+4·563
		τ Octantis - - -	13 3 9·43	13 0 47·76	
Aug. 29	E.	Lacaille 7088 - -	6 37 59·28	6 37 23·48	
		Lacaille 7078 - -	6 53 19·12	6 52 21·33	+4·624
		Lacaille 2066 S.P. -	6 52 50·73	6 53 17·95	
	W.	* S.P. - - -	7 37 25·07	7 39 31·06	+4·559
		σ Octantis - - -	8 2 7·04	7 56 41·93	
	W.	B Octantis - - -	10 49 56·56	10 43 29·53	
		Lacaille 3981 S.P. -	10 54 56·73	10 55 9·00	+4·599
		Lacaille 8798 - -	11 0 47·67	11 0 2·50	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	s
Aug. 29	E.	C Octantis - -	11 37 20·23	11 36 4·57	+4·550
		Lacaille 4510 S.P. -	12 3 56·38	12 4 36·20	
			Instrument moved in Azimuth.		
Sept. 2	E.	Lacaille 1921 S.P. -	6 24 40·34	6 24 30·71	−0·106
		Lacaille 7078 - -	6 36 44·65	6 36 36·81	
	W.	Lacaille 7751 - -	8 7 22·98	8 7 13·54	−0·011
		Lacaille 3274 S.P. -	8 39 38·14	8 39 28·41	
	W.	Lacaille 3537 S.P. -	9 42 58·92	9 42 49·39	−0·104
		Lacaille 8570 - -	10 2 11·85	10 2 3·26	
	W.	B Octantis - -	10 27 45·73	10 27 43·52	−0·085
Sept. 13	W.	σ Octantis - -	6 58 20·26	6 57 21·49	+0·010
		ζ Mensæ S.P. - -	7 19 27·19	7 18 28·64	
	E.	τ Octantis - -	11 39 10·83	11 38 15·59	−0·108
Sept. 18	W.	σ Octantis - -	6 38 22·92	6 37 34·79	−0·050
		ζ Mensæ S.P. - -	6 59 41·57	6 58 49·74	
	E.	Lacaille 3274 S.P. -	7 37 30·70	7 36 38·88	−0·013
		Lacaille 8094 - -	7 44 2·02	7 43 10·49	
Sept. 19	E.	σ Octantis - -	6 34 27·52	6 33 37·33	−0·009
		ζ Mensæ S.P. - -	6 55 44·84	6 54 53·95	
	W.	Lacaille 3274 S.P. -	7 33 34·48	7 32 43·32	−0·022
		Lacaille 8094 - -	7 40 5·79	7 39 14·45	
		A Octantis S.P. - -	8 11 8·93	8 10 16·64	
		Lacaille 8257 - -	8 20 3·76	8 19 13·73	
	W.	Lacaille 5325 S P. -	12 59 20·75	12 58 30·12	−0·030
		Lacaille 505 - -	13 37 47·98	13 36 57·95	
	E.	Lacaille 5633 S.P. -	13 45 24·66	13 44 33·88	−0·011
		Lacaille 637 - -	14 0 54·65	14 0 4·99	
Sept. 22	E.	σ Octantis - -	6 22 25·90	6 21 44·48	−0·077
		ζ Mensæ S.P. - -	6 43 53·75	6 43 6·63	
	W.	Lacaille 3274 S.P. -	7 21 43·43	7 20 56·66	−0·012
	W.	Lacaille 248 - -	12 33 12·10	12 32 25·74	−0·002
		Lacaille 5268 S.P. -	12 35 38·84	12 34 52·43	
	E.	Lacaille 5633 S.P. -	13 33 33·22	13 32 45·80	−0·140
		Lacaille 634 - -	13 37 27·85	13 36 42·79	
Sept. 23	E.	ζ Mensæ S.P. - -	6 39 57·26	6 39 10·86	−0·161
		Lacaille 8094 - -	7 24 14·92	7 23 30·32	
	W.	A Octantis S.P. - -	7 55 15·67	7 54 35·79	+0·157
		Lacaille 8257 - -	8 4 16·02	8 3 29·36	
	W.	Lacaille 4784 S.P. -	11 12 49·56	11 12 4·16	+0·125
		Lacaille 9464 - -	11 17 33·97	11 16 45·39	
	E.	Brisbane 4091 S.P. -	12 23 30·80	12 22 33·30	−0·201
		Lacaille 248 - -	12 29 12·88	12 28 29·88	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881.					
Sept. 26	W.	ζ Mensæ S.P. - -	6 28 5·88	6 27 23·53	
		Lacaille 7751 - -	6 33 26·38	6 32 46·72	−0·056
		Lacaille 3274 S.P. -	7 5 55·48	7 5 14·48	
		Lacaille 8094 - -	7 12 22·81	7 11 42·20	
	E.	Lacaille 8257 - -	7 52 22·27	7 51 41·04	
		Lacaille 3537 S.P. -	8 9 11·20	8 8 29·87	+0·024
		Lacaille 8570 - -	8 28 21·78	8 27 40·17	
		ζ Octantis S.P. - -	8 51 15·70	8 50 34·57	
	E.	Lacaille 235 - -	12 21 50·88	12 21 10·20	−0·043
		Lacaille 5325 S.P. -	12 31 39·79	12 30 58·27	
	W.	κ Octantis S.P. - -	12 59 4·87	12 58 23·48	−0·007
		Lacaille 505 - -	13 10 8·21	13 9 26·92	
Sept. 28	W.	Lacaille 7751 - -	6 25 33·01	6 24 54·45	−0·155
		Lacaille 3274 S.P. -	6 58 5·94	6 57 23·43	
	E.	A Octantis S.P. - -	7 35 41·36	7 34 59·95	−0·047
		Lacaille 8257 - -	7 44 28·20	7 43 48·84	
Nov. 20	E.	Lacaille 4991 S.P. -	7 59 8·09	7 56 53·24	−8·296
		Lacaille 9745 - -	8 1 50·12	8 3 1·75	
	W.	Lacaille 1752 - -	12 58 45·02	12 58 19·24	−8·503
		Lacaille 7088 S.P. -	13 10 36·11	13 8 57·63	
Nov. 21	W.	Lacaille 1444 - -	12 4 13·99	12 4 0·58	−8·742
		Lacaille 6727 S.P. -	12 12 39·80	12 11 9·90	
	E.	Lacaille 2296 - -	13 48 22·42	13 48 50·29	−8·442
		Lacaille 7751 S.P. -	14 52 41·98	14 50 26·41	
			Instrument moved in Azimuth.		
Nov. 26	E.	Lacaille 1592 - -	11 41 34·19	11 40 56·94	−0·571
		Lacaille 6727 S.P. -	11 52 16·63	11 51 30·47	
Nov. 27	W.	ε Octantis S.P. - -	10 4 59·76	10 4 4·69	
		Lacaille 972 - -	10 24 27·98	10 23 47·96	−0·550
		Lacaille 1444 - -	11 41 4·75	11 40 25·06	
Dec. 23	W.	Lacaille 1105 - -	9 2 14·96	9 1 50·93	+0·643
		Lacaille 6216 S.P. -	9 6 40·20	9 6 24·52	
	E.	Lacaille 6484 S.P. -	9 33 55·41	9 33 36·55	+0·691
		Lacaille 1592 - -	9 55 13·30	9 54 43·88	
	E.	Lacaille 3238 - -	13 46 52·20	13 46 27·45	+0·660
		Lacaille 8257 S.P. -	14 3 41·15	14 3 26·40	
	W.	Lacaille 8570 S.P. -	14 39 54·66	14 39 35·27	+0·425
		ζ Octantis - -	15 3 22·89	15 2 57·47	
1882.					
Jan. 8	W.	Lacaille 9401 S.P. -	16 3 3·71	16 2 55·43	+0·351
		Lacaille 4784 - -	16 10 0·21	16 9 43·80	
	E.	Lacaille 9563 S.P. -	16 25 39·58	16 25 30·32	+0·471
		Lacaille 4974 -	16 39 58·54	16 39 43·17	
Jan. 14	E.	✳ S.P. - - -	9 20 8·79	9 20 13·07	+0·793
		Lacaille 1921 - -	9 36 3·88	9 35 48·43	
	W.	ζ Mensæ - - -	11 13 16·57	11 13 3·42	+0·598
		Lacaille 7751 S.P. -	11 18 10·72	11 18 6·56	

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
Jan. 20	E.	Lacaille 5085 - -	16 10 19·81	16 10 10·86	+0·579
		β Hydri S.P. - -	16 18 9·96	16 18 5·81	
	W.	Lacaille 248 S.P. -	16 38 9·87	16 38 10·52	+0·514
		ι Octantis - -	16 41 36·46	16 41 25·50	
Jan. 21	W.	✳ S.P. - - -	8 52 39·14	8 52 44·69	
		✳ S.P. - - -	10 8 34·87	10 8 12·35	+0·560
		σ Octantis S.P. -	10 22 18·06	10 22 48·48	
	E.	Lacaille 3274 - -	11 23 57·17	11 23 40·27	+0·704
		Lacaille 8094 S.P. -	11 29 36·02	11 29 34·32	
Jan. 27	E.	Lacaille 1752 - -	8 31 2·54	8 30 55·09	+0·562
		Lacaille 7088 S.P. -	8 41 43·24	8 41 40·62	
	W.	Lacaille 2210 - -	9 30 34·58	9 30 26·76	+0·490
		σ Octantis S.P. - -	9 58 51·75	9 59 19·56	
	W.	Lacaille 8570 S.P. -	12 22 1·48	12 21 57·98	+0·468
		ζ Octantis - -	12 45 33·91	12 45 23·76	
	E.	Lacaille 4169 - -	13 19 31·46	13 19 18·40	+0·566
		C Octantis S.P. - -	13 39 45·95	13 39 47·26	

SECTION VI.—TABLE 8.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. MACLEAR.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 18	23 Ophiuchi - - -	W.	6 59 59·42	5	1·05	32·07	−28·98
	37 Ophiuchi - - -		7 18 32·26	5	35·03	5·89	−29·14
	41 Ophiuchi - - -		7 22 11·68	5	13·68	44·47	−29·21
	40 Ophiuchi - - -		7 25 35·28	5	35·78	6·68	−29·10
	μ^1 Sagittarii - - -	E.	8 18 13·38	5	13·97	44·72	−29·25
	Lalande 33596 - -		8 21 38·14	5	40·42	11·19	−29·23
	Rumker 6386 - -		8 24 54·94	5	57·55	28·45	−29·10
	B.A.C. 6388 - - -		8 52 19·14	5	20·83	51·69	−29·14
	ε Aquilæ - - -		9 5 36·76	5	39·85	10·73	−29·12
	ζ Aquilæ - - -		9 11 19·08	4	22·07	52·97	−29·10
	α Equulei - - -	E.	11 20 55·00	5	57·21	28·30	−28·91
	ξ Aquarii - - -		11 42 24·88	3	26·17	57·42	−28·75
	41 Capricorni - - -		11 46 14·92	5	15·03	46·16	−28·87
	46 Capricorni - - -		11 49 38·42	5	39·63	10·76	−28·87
	γ Aquarii - - -	W.	12 26 22·66	4	24·31	55·68	−28·63
	π Aquarii - - -		12 30 3·26	5	5·11	36·49	−28·62
	σ Aquarii - - -		12 34 12·34	4	13·38	44·60	−28·78
	κ Aquarii - - -		12 42 25·28	5	26·79	58·05	−28·74

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 19	20 Ophiuchi	W.	6 51 4·46	5	5·82	38·02	−27·80
	23 Ophiuchi		6 56 2·32	5	4·00	36·16	−27·84
	37 Ophiuchi		7 14 34·82	5	37·67	9·98	−27·69
	41 Ophiuchi		7 18 14·30	5	16·38	48·55	−27·83
	Lalande 33262	E.	8 9 11·86	5	14·78	47·01	−27·77
	μ^1 Sagittarii		8 14 15·62	5	16·39	48·81	−27·58
	Rumker 6386		8 20 57·40	4	0·23	32·53	−27·70
	B.A.C. 6279		8 29 58·36	5	59·62	32·21	−27·41
	ζ Aquilæ		9 7 21·68	5	24·90	57·06	−27·84
	B.A.C. 7665	E.	12 3 38·32	5	39·06	11·46	−27·60
	ι Aquarii		12 6 58·84	5	59·89	32·44	−27·45
	e Aquarii		12 11 13·38	5	14·60	46·84	−27·76
	γ Aquarii		12 22 25·40	5	27·35	59·79	−27·56
	2 Piscium	W.	13 0 9·96	5	11·85	44·46	−27·39
	h^1 Aquarii		13 5 45·60	5	46·89	19·45	−27·44
	c^2 Aquarii		13 9 54·54	4	54·83	27·47	−27·36
	κ Piscium		13 27 33·90	3	35·81	8·32	−27·49
	ι Piscium		13 40 31·02	5	33·23	6·02	−27·21
Aug. 20	14 Ophiuchi	W.	6 39 33·26	5	35·40	8·89	−26·51
	25 Scorpii		6 43 28·58	5	28·76	2·25	−26·51
	23 Ophiuchi		6 52 5·02	5	6·65	40·22	−26·43
	Lalande 31210		7 2 52·30	5	53·46	27·04	−26·42
	57 Ophiuchi	E.	7 35 6·68	5	8·40	41·97	−26·43
	o Serpentis		7 38 27·60	5	28·96	2·50	−26·46
	γ Ophiuchi		7 45 37·04	5	39·52	12·95	−26·57
	Lalande 32923		7 56 58·08	4	0·00	33·47	−26·53
	μ^1 Sagittarii		8 10 18·74	5	19·40	52·89	−26·51
	η Capricorni	E.	11 0 49·94	5	50·54	24·28	−26·26
	ν Aquarii		11 6 17·10	5	18·36	51·95	−26·41
	α Equulei		11 13 0·50	5	2·97	36·49	−26·48
	ζ Capricorni		11 23 1·12	5	1·50	35·15	−26·35
	16 Piscium	W.	13 33 4·04	5	5·98	39·79	−26·19
	ι Piscium		13 36 34·04	5	36·22	10·11	−26·11
	i^1 Aquarii		13 40 47·00	5	47·51	21·36	−26·15
	22 Piscium		13 48 34·82	5	36·82	10·59	−26·23
Aug. 23	ϕ Ophiuchi	W.	6 16 24·48	5	25·40	2·07	−23·33
	25 Scorpii		6 31 37·66	5	37·84	14·49	−23·35
	20 Ophiuchi		6 35 16·26	5	17·62	54·33	−23·29
	30 Ophiuchi		6 46 45·83	4	47·66	24·38	−23·28
	51 Ophiuchi	E.	7 16 5·46	3	5·92	42·47	−23·45
	α Ophiuchi		7 21 16·14	5	19·32	56·01	−23·31
	o Serpentis		7 26 36·90	5	38·22	14·74	−23·48
	γ Ophiuchi		7 33 46·20	5	48·63	25·18	−23·45
	μ^1 Sagittarii		7 58 27·86	5	28·45	5·11	−23·34
	B.A.C. 7649	E.	11 43 17·98	5	18·23	55·22	−23·01
	ι Aquarii		11 51 11·00	5	11·85	48·83	−23·02
	e Aquarii		11 55 25·19	4	26·20	3·23	−22·97
	γ Aquarii		12 6 37·34	5	39·09	16·18	−22·91
	2 Piscium	W.	12 44 21·94	5	23·86	0·86	−23·00
	h^1 Aquarii		12 49 57·60	5	58·89	35·86	−23·03
	c^2 Aquarii		12 54 6·50	5	6·76	43·89	−22·87
	κ Piscium		13 11 45·86	5	47·83	24·73	−23·10

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 29	37 Ophiuchi	E.	6 35 1·18	5	4·22	50·74	−13·48
	Lalande 31606		6 45 46·30	5	46·96	33·70	−13·26
	o Serpentis		7 2 51·20	5	52·50	39·21	−13·29
	γ Ophiuchi		7 10 0·60	5	3·02	49·65	−13·37
	μ^1 Sagittarii	W.	7 34 42·76	5	43·19	29·59	−13·60
	Rumker 6386		7 41 24·24	5	26·74	13·32	−13·42
	B.A.C. 6279		7 50 25·44	5	26·37	13·00	−13·37
	61 Serpentis		7 53 47·04	5	48·96	35·55	−13·41
	ζ Capricorni	W.	10 47 25·08	5	25·33	11·99	−13·34
	ϵ Pegasi		11 5 47·20	5	49·85	36·66	−13·19
	27 Aquarii		11 8 38·80	5	40·93	27·69	−13·24
	Lalande 42574		11 12 33·48	5	34·04	20·68	−13·36
	B.A.C. 7628		11 15 23·92	5	25·55	12·13	−13·42
	γ Aquarii	E.	11 42 51·70	4	53·68	40·78	−12·90
	σ Aquarii		11 51 41·44	5	42·73	29·71	−13·02
	υ Aquarii		11 54 31·78	5	32·29	19·28	−13·01
	κ Aquarii		11 58 54·50	5	56·25	43·15	−13·10
	λ Aquarii		12 13 41·02	5	42·51	29·50	−13·01
Sept. 2	κ Ophiuchi	E.	6 4 29·52	5	29·44	20·27	− 9·17
	η Ophiuchi		6 15 59·30	5	59·21	50·16	− 9·05
	37 Ophiuchi		6 19 16·16	5	16·06	7·04	− 9·02
	B.A.C. 5890		6 32 42·12	5	42·03	33·09	− 8·94
	μ^1 Sagittarii	W.	7 18 55·50	5	55·08	45·90	− 9·18
	30 Sagittarii		7 55 52·20	4	51·76	42·55	− 9·21
	θ Serpentis		8 2 27·40	5	27·03	17·77	− 9·26
	δ Aquilæ		8 31 34·52	5	34·14	24·75	− 9·39
Sept. 13	Lalande 33262	W.	6 31 27·30	5	27·06	29·79	−58·27
	μ^1 Sagittarii		6 36 29·12	5	28·83	30·74	−58·09
	Rumker 6386		6 43 12·92	5	12·67	14·47	−58·20
	21 Sagittarii		6 48 4·46	5	4·16	5·86	−58·30
	h^2 Sagittarii	E.	7 59 4·70	5	4·56	6·79	−57·77
	γ Aquilæ		8 10 10·50	5	10·36	12·38	−57·98
	α Aquilæ		8 14 32·28	5	32·14	34·25	−57·89
	η Aquilæ		8 15 58·39	3	58·25	0·17	−58·08
	β Aquilæ		8 19 1·20	5	1·06	3·01	−58·05
Sept. 18	μ^1 Sagittarii	W.	6 16 43·06	5	42·72	51·12	−51·62
	21 Sagittarii		6 28 18·16	5	17·82	26·24	−51·58
	B.A.C. 6367		6 47 1·60	5	1·29	9·62	−51·67
	30 Sagittarii		6 53 39·56	5	39·22	47·79	−51·43
	B.A.C. 6488		7 4 42·08	5	41·75	50·00	−51·75
	e Aquilæ	E.	7 34 17·74	5	17·51	25·95	−51·56
	51 Aquilæ		7 54 2·38	5	2·10	10·46	−51·64
	β Aquilæ		7 59 15·20	5	14·95	23·42	−51·53
	63 Sagittarii		8 5 5·58	5	5·27	13·41	−51·86
Sept. 19	Rumker 6386	E.	6 19 29·94	5	29·67	38·92	−50·75
	η Serpentis		6 21 14·68	4	14·38	23·68	−50·70
	λ Sagittarii		6 26 42·98	5	42·60	51·90	−50·70
	B.A.C. 6488		7 0 45·26	5	44·88	54·07	−50·81
	υ Aquilæ	W.	7 26 21·36	5	20·90	30·04	−50·86
	e Aquilæ		7 30 21·46	5	20·99	30·02	−50·97
	γ Aquilæ		7 46 28·14	5	27·69	36·85	−50·84
	η Aquilæ		7 52 15·92	5	15·50	24·65	−50·85
	34 Ceti		13 10 39·78	5	39·34	48·64	−50·70
	39 Ceti		13 15 32·32	5	31·88	41·28	−50·60
	42 Ceti		13 18 41·26	5	40·83	50·23	−50·60

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 19	*o* Piscium	E.	13 44 0·32	5	59·97	9·50	−50·47
	61 Ceti		14 2 33·24	5	32·85	42·34	−50·51
	Lalande 8979		14 7 56·50	5	56·04	5·59	−50·45
	ξ^1 Ceti		14 11 30·68	5	30·32	39·86	−50·46
	67 Ceti		14 15 50·96	5	50·54	0·16	−50·38
Sept. 22	B.A.C. 6367	E.	6 31 13·20	5	12·80	25·91	−46·89
	B.A.C. 6388		6 35 1·74	5	1·36	14·44	−46·92
	ϵ Aquilæ		6 48 20·68	5	20·35	33·44	−46·91
	ν Aquilæ	W.	7 14 29·66	5	29·29	42·26	−47·03
	e Aquilæ		7 18 29·58	5	29·20	42·25	−46·95
	h^2 Sagittarii		7 23 30·50	3	30·05	43·48	−46·57
	γ Aquilæ		7 34 36·42	5	36·09	49·09	−47·00
	η Aquilæ		7 40 24·08	5	23·71	36·80	−46·91
	Lalande 1994	W.	12 54 55·54	5	55·01	8·31	−46·70
	34 Ceti		12 58 48·10	5	47·61	0·95	−46·66
	39 Ceti		13 3 40·64	3	40·15	53·60	−46·55
	42 Ceti		13 6 49·59	4	49·11	2·54	−46·57
	θ Ceti		13 11 10·12	5	9·60	22·96	−46·64
	112 Piscium	E.	13 46 57·34	5	56·73	10·45	−46·28
	61 Ceti		13 50 41·56	5	40·94	54·67	−46·27
	α Arietis		13 53 26·66	5	26·12	39·92	−46·20
Sept. 23	B.A.C. 6367	E.	6 27 15·66	5	15·19	29·99	−45·20
	B.A.C. 6388		6 31 4·10	5	3·62	18·52	−45·10
	30 Sagittarii		6 33 53·88	5	53·39	8·16	−45·23
	ϵ Aquilæ		6 44 23·08	5	22·60	37·51	−45·09
	ζ Aquilæ		6 50 5·41	3	4·93	19·79	−45·14
	ω Aquilæ		7 2 21·11	3	20·60	35·33	−45·27
	63 Sagittarii	W.	7 45 19·76	5	19·40	33·80	−45·60
	τ Aquilæ		7 48 19·92	5	19·69	33·84	−45·85
	a^2 Capricorni		8 1 25·60	5	25·26	39·70	−45·56
	ρ Capricorni		8 12 1·44	4	1·06	15·33	−45·73
	ϵ Aquarii		8 31 7·70	5	7·37	21·78	−45·59
	κ Piscium	W.	11 10 17·80	5	17·42	31·84	−45·58
	ι Piscium		11 23 15·54	4	15·19	29·58	−45·61
	i^1 Aquarii		11 27 26·96	5	26·45	40·84	−45·61
	22 Piscium		11 35 16·14	4	15·77	30·10	−45·67
	12 Ceti	E.	12 13 15·03	4	14·39	29·49	−44·90
	13 Ceti		12 18 23·84	5	23·20	38·08	−45·12
	β Ceti		12 26 51·96	5	51·30	6·20	−45·10
	20 Ceti		12 36 9·12	5	8·49	23·39	−45·10
Sept. 26	*d* Sagittarii	W.	6 48 56·96	5	56·53	14·99	−41·54
	υ Sagittarii		6 53 10·60	4	10·18	28·64	−41·54
	δ Aquilæ		6 57 44·44	5	44·07	52·63	−41·44
	h^2 Sagittarii		7 7 41·77	4	41·31	59·78	−41·53
	γ Aquilæ		7 18 47·14	5	46·78	5·39	−41·39
	β Aquilæ		7 27 37·83	4	37·47	56·03	−41·44
	ϵ Delphini	E.	8 5 35·27	3	34·90	53·50	−41·40
	Lalande 40029		8 15 47·52	5	47·10	5·49	−41·61
	ϵ Aquarii		8 19 16·18	4	15·70	34·02	−41·68
	ω Capricorni		8 22 45·10	5	44·53	2·93	−41·60
	α Equulei		8 47 49·70	5	49·26	7·68	−41·58
	22 Ceti		12 27 24·88	5	24·22	42·92	−41·30
	ϵ Piscium		12 34 6·44	5	5·87	24·63	−41·24
	Lalande 1994		12 39 6·66	5	6·01	24·72	−41·29
	34 Ceti		12 42 59·44	5	58·82	17·37	−41·45

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 26	θ^1 Ceti	W.	12 55 21·39	2	20·82	39·38	− 41·44
	o Piscium		13 16 19·94	5	19·46	38·25	− 41·21
	54 Ceti		13 21 45·68	5	45·20	3·93	− 41·27
	ξ Piscium		13 24 35·82	5	35·31	53·89	− 41·42
	56 Ceti		13 28 16·98	5	16·32	35·12	− 41·20
Sept. 28	19 Aquilæ	W.	6 33 33·54	5	33·08	53·66	− 39·42
	20 Aquilæ		6 36 36·54	5	36·05	56·67	− 39·38
	ω Aquilæ		6 42 35·54	5	35·07	55·71	− 39·36
	υ Sagittarii		6 45 16·66	5	16·16	36·79	− 39·37
	δ Aquilæ		6 49 50·60	5	50·11	10·79	− 39·32
	63 Sagittarii	E.	7 25 34·14	4	33·75	54·20	− 39·55
	τ Aquilæ		7 28 34·10	5	33·76	54·23	− 39·53
	ρ Capricorni		7 52 15·32	5	14·83	35·73	− 39·10
	ϵ Delphini		7 57 41·24	5	40·85	1·66	− 39·19
Nov. 20	B.A.C. 8311	E.	7 50 9·14	5	5·07	15·64	− 49·43
	ω Piscium		7 54 40·06	5	35·14	45·81	− 49·33
	d Piscium		8 15 53·39	4	48·30	59·03	− 49·27
	12 Ceti		8 25 19·80	5	16·25	26·75	− 49·50
	ι Orionis	W.	13 2 2·94	4	57·59	8·39	− 49·20
	λ Eridani		13 4 2·88	4	59·76	10·47	− 49·29
	τ Orionis		13 12 24·36	4	20·99	31·72	− 49·27
	o Orionis		13 16 16·22	5	12·00	22·75	− 49·25
Nov. 21	Lalande 8736	W.	12 28 22·31	4	18·25	29·69	− 48·56
	54 Eridani		12 31 56·29	4	54·60	6·05	− 48·55
	π^5 Orionis		12 45 46·86	5	42·15	53·51	− 48·64
	64 Eridani		12 51 4·24	5	1·52	12·86	− 48·66
	66 Orionis	E.	13 55 13·52	5	8·74	19·79	− 48·95
	B.A.C. 1965		13 58 1·93	4	0·79	11·84	− 48·95
	10 Monocerotis		14 18 32·10	5	28·42	39·50	− 48·92
	B Moncerotis		14 22 56·16	5	50·94	2·19	− 48·75
Nov. 26	Lalande 7384	E.	11 30 3·72	4	3·25	20·15	− 43·10
	ν Tauri		11 33 52·54	5	51·99	8·89	− 43·10
	45 Eridani		12 1 45·62	5	45·09	1·86	− 43·23
	W.B. IV–585		12 5 27·24	5	26·76	43·62	− 43·14
	Lalande 8736		12 8 33·64	5	33·11	50·20	− 42·91
	54 Eridani		12 12 9·80	5	9·37	26·56	− 42·81
	Lalande 9045		12 19 10·36	5	9·91	26·90	− 43·01
	π^4 Orionis		12 21 46·98	5	46·39	3·59	− 42·80
Nov. 27	ξ^1 Ceti	W.	9 40 5·92	5	5·38	22·78	− 42·60
	67 Ceti		9 44 25·96	5	25·52	43·05	− 42·47
	B.A.C. 737		9 50 27·58	5	27·26	44·78	− 42·48
	ρ Ceti		9 53 33·62	5	33·22	50·68	− 42·54
	τ^6 Eridani		11 14 51·50	5	51·17	8·83	− 42·34
	30 Eridani		11 19 56·76	5	56·31	13·70	− 42·61
	Lalande 7273		11 22 47·45	4	47·05	4·52	− 42·53
	Lalande 7384		11 26 7·22	5	6·77	24·25	− 42·52
	ν Tauri		11 29 55·01	4	55·49	12·99	− 42·50
Dec. 23	ρ^1 Eridani	W.	8 49 6·46	5	6·41	44·63	− 21·78
	94 Ceti		8 57 21·38	5	21·40	59·68	− 21·72
	ζ Eridani		9 0 41·90	5	41·84	20·11	− 21·73
	Lalande 6476		9 14 35·08	5	34·96	13·40	− 21·56
	Lalande 7273	E.	9 40 12·62	5	12·68	50·87	− 21·81
	Lalande 7384		9 43 32·30	5	32·45	10·61	− 21·84
	ν Tauri		9 47 20·86	5	21·15	59·38	− 21·77
	Lalande 7685		9 51 47·06	5	47·05	25·36	− 21·69

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Dec. 23	9 Argûs	E.	13 36 9·16	4	9·05	47·44	− 21·61
	27 Monocerotis		13 43 39·88	5	39·91	18·23	− 21·68
	ζ Monocerotis		13 52 27·80	5	27·84	6·12	− 21·72
	β Cancri		13 59 53·58	5	53·76	32·08	− 21·68
	15 Hydræ	W.	14 36 27·38	5	27·15	5·58	− 21·57
	B.A.C. 3082		14 45 43·68	5	43·24	21·80	− 21·44
	κ Cancri		14 50 59·42	5	59·35	37·84	− 21·51
1882.	θ Hydræ		14 57 50·46	5	50·32	28·88	− 21·44
Jan. 8	β Crateris	W.	15 52 7·00	5	6·45	52·82	− 13·63
	φ Leonis		15 56 54·30	5	53·96	40·39	− 13·57
	θ Crateris		16 16 52·98	5	52·58	39·04	− 13·54
	Lalande 22102		16 20 3·52	5	3·06	49·50	− 13·56
	η Crateris	E.	16 36 8·10	5	7·72	54·19	− 13·53
	B.A.C. 4077		16 46 3·34	5	3·14	49·56	− 13·58
	ε Corvi		16 50 9·20	5	8·75	55·13	− 13·62
	η Virginis		16 59 55·90	5	55·72	42·03	− 13·69
Jan. 14	64 Eridani	E.	9 18 4·22	5	4·27	53·86	− 10·41
	Lalande 10145		9 42 10·92	5	11·17	0·69	− 10·48
	Lalande 10325		9 47 3·64	5	3·79	53·33	− 10·46
	υ Orionis		9 49 45·82	5	45·91	35·42	− 10·49
	18 Monocerotis	W.	11 5 3·30	5	2·83	52·36	− 10·47
	θ Canis Majoris		11 12 2·20	5	1·52	51·17	− 10·35
	20 Monocerotis		11 27 39·02	5	38·46	28·20	− 10·26
	26 Canis Majoris		11 30 39·48	5	38·55	28·17	− 10·38
	B.A.C. 2405		11 35 7·40	5	6·44	56·06	− 10·38
	B.A.C. 2433		11 39 15·32	5	14·82	4·51	− 10·31
Jan. 20	Lalande 22818	E.	16 2 50·38	5	50·51	43·55	− 6·96
	12 Virginis		16 6 12·74	5	12·95	5·80	− 7·15
	δ^2 Corvi		16 22 30·58	5	30·42	23·43	− 6·99
	Piazzi XII–111		16 24 19·23	4	19·21	12·06	− 7·15
	B.A.C. 4238		16 27 14·48	5	14·64	7·51	− 7·13
	44 Virginis	W.	16 52 14·90	5	14·34	7·45	− 6·89
	ε Virginis		16 54 57·36	5	56·69	50·26	− 6·43
	B.A.C. 4382		16 58 52·64	5	51·92	45·04	− 6·88
	θ Virginis		17 2 28·92	5	28·34	21·33	− 7·01
Jan. 21	π^5 Orionis	W.	8 44 10·00	5	9·65	3·13	− 6·52
	64 Eridani		8 50 29·60	5	29·06	22·44	− 6·62
	τ Orionis		9 7 52·54	5	52·08	45·54	− 6·54
	ν Orionis		9 56 42·24	5	42·04	35·41	− 6·63
	B.A.C. 2470	E.	11 17 57·46	5	57·52	50·66	− 6·86
	o Puppis		11 38 46·32	5	46·12	39·37	− 6·75
	9 Argûs		11 41 53·28	5	53·25	46·36	− 6·89
	B.A.C. 2636		11 44 40·92	5	41·24	34·48	− 6·76
	6 Cancri		11 51 49·22	5	49·88	42·92	− 6·96
Jan. 27	λ Eridani	E.	8 35 54·64	4	54·52	48·73	− 5·79
	o Orionis		8 48 7·12	5	7·10	1·11	− 5·99
	Lalande 10145		8 50 59·66	5	59·66	53·77	− 5·89
	Lalande 10325		8 55 52·52	5	52·44	46·42	− 6·02
	5 Monocerotis	W.	9 41 20·87	4	20·25	14·30	− 5·95
	7 Monocerotis		9 46 15·78	5	15·14	9·19	− 5·95
	10 Monocerotis		9 54 20·74	5	20·14	14·12	− 6·02
	γ Geminorum		10 3 4·92	5	4·58	58·63	− 5·95
	B.A.C. 2954	W.	12 9 43·32	5	42·65	36·79	− 5·86
	ε Hydræ		12 12 21·68	5	21·18	15·31	− 5·87
	15 Hydræ		12 17 35·92	5	35·26	29·28	− 5·98
	κ Cancri		12 33 7·90	5	7·46	1·63	− 5·83
	13 Sextantis	E.	13 29 38·44	5	38·44	32·56	− 5·88
	A Leonis		13 33 14·72	5	14·82	8·97	− 5·85
	25 Sextantis		13 49 2·32	5	2·20	46·36	− 5·84
	μ Hydræ		13 51 56·38	5	56·08	50·28	− 5·80

Digitized by Google

SECTION VI.—TABLE 9.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.
1882.	r	r	s	s
July 10	10·312	10·313	−0·012	−0·024
July 13	10·301	10·313	+0·026	−0·062

SECTION VI.—TABLE 10.

DETERMINATION OF LEVEL ERROR WITH THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.
1882.		div.	s	1882.		div.	s
July 10	E.	−0·33	−·051	July 13	E.	−0·46	−·063
	E.	−1·38	−·148*		E.	−0·93	−·107*
	W.	−1·50	−·119		W.	−1·01	−·083
	W.	−0·91	−·064*		W.	−1·21	
	W.	−1·51	−·120		W.	−1·34	−·089
	W.	−0·66	−·041*		W.	−1·00	
	E.	−1·25	−·137		E.	−1·60	−·173
	E.	−2·01	−·208*		E.	−2·29	−·233*

SECTION VI.—TABLE 11.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Apparent Time of Transit.	Azimuth Error.
1882.			h m s	h m s	s
July 10	E.	Lacaille 972 S.P. -	7 37 42·39	7 37 2·48	+1·485
		Lacaille 6216 - -	8 3 22·03	8 2 24·72	
	W.	Lacaille 6484 - -	8 30 16·41	8 29 26·33	+1·230
		Lacaille 1592 S.P. -	8 50 16·77	8 49 45·44	
	W.	Lacaille 3274 S.P. -	12 12 47·79	12 12 21·89	+1·194
		Lacaille 8094 - -	12 20 26·58	12 19 34·85	
	E.	Lacaille 3238 S.P. -	12 42 22·09	12 41 44·75	+1·356
		Lacaille 8094 - -	13 4 22·15	13 3 29·10	
July 13	E.	Lacaille 1105 S.P. -	7 46 3·03	7 45 28·94	+1·465
		Lacaille 6216 - -	7 51 29·72	7 50 36·57	
	W.	Lacaille 1592 S.P. -	8 38 24·99	8 37 58·05	+1·233
		Lacaille 6727 - -	8 50 12·90	8 49 26·72	
	W.	Lacaille 3274 S.P. -	12 0 53·92	12 0 33·96	+1·320
		Lacaille 8094 - -	12 8 35·70	12 7 47·24	
	E.	Lacaille 3238 S.P. -	12 30 29·94	12 29 56·92	+1·357
		Lacaille 8360 - -	12 52 30·32	12 51 41·57	

Digitized by Google

SECTION VI.—TABLE 12.

OBSERVATIONS WITH THE SMALL TRANSIT AT DURBAN BY MR. PETT.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1882.			h m s		s	s	s
July 10	110 Virginis	E.	7 43 35·06	5	35·77	49·86	−45·91
	ν Libræ		7 46 41·62	5	41·89	56·14	−45·75
	ι Libræ		7 52 8·08	5	8·23	22·40	−45·83
	3 Serpentis		7 55 56·04	5	56·78	10·91	−45·87
	50 Libræ	W.	8 40 55·16	5	55·52	10·06	−45·46
	51 Libræ		8 44 22·02	5	22·32	36·91	−45·41
	11 Scorpii		8 47 32·08	5	32·36	46·91	−45·47
	ψ Ophiuchi		9 8 38·62	5	38·77	53·23	−45·54
	15 Aquilæ	W.	11 44 43·66	5	44·07	58·62	−45·45
	19 Aquilæ		11 49 11·74	5	12·35	27·01	−45·34
	20 Aquilæ		11 52 15·34	5	15·70	30·24	−45·46
	d Sagittarii		11 56 42·14	5	42·28	56·93	−45·35
	Lalande 38458	E.	12 47 38·16	5	38·52	52·92	−45·60
	ξ Capricorni		12 51 40·44	5	40·67	55·24	−45·43
	α^1 Capricorni		12 56 54·70	5	54·92	9·36	−45·56
	Washington 8892		13 10 13·70	5	13·84	28·37	−45·47
July 13	37 Libræ	E.	8 2 26·22	5	26·59	44·86	−41·73
	41 Libræ		8 6 49·04	5	49·17	7·71	−41·46
	κ Libræ		8 9 50·64	5	50·76	9·10	−41·66
	ψ Serpentis		8 12 45·98	5	46·64	4·97	−41·67
	51 Libræ	W.	8 32 30·16	5	30·52	49·16	−41·36
	18 Scorpii		8 43 48·02	5	48·43	6·95	−41·48
	Lalande 29689		8 46 55·88	5	56·17	14·86	−41·31
	χ Ophiuchi		8 54 45·30	5	45·50	4·17	−41·33
	20 Aquilæ	W.	11 40 23·44	5	23·89	42·53	−41·36
	d Sagittarii		11 44 50·26	5	50·46	9·21	−41·25
	υ Sagittarii		11 49 3·86	5	4·13	22·77	−41·36
	ν Aquilæ		11 54 32·94	5	33·55	52·37	−41·18
	β Aquilæ	E.	12 23 30·50	5	31·09	49·58	−41·51
	Lalande 38458		12 35 46·40	5	46·68	5·23	−41·45
	ξ Capricorni		12 39 48·76	5	48·91	7·55	−41·36
	α^1 Capricorni		12 45 2·96	5	3·10	21·66	−41·44

Digitized by Google

Digitized by Google

SECTION VII.

OBSERVATIONS AT ADEN BY MR. FINLAY.

	Page
TABLE 1.—Determination of Collimation Error - - - -	76
„ 2.— „ Level Error - - - -	76
„ 3.— „ Azimuth Error - - - -	78
„ 4.—Transit Observations - - - - - -	80

Digitized by Google

SECTION VII.—TABLE 1.

DETERMINATION OF COLLIMATION ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.		Date.	Reading for Geometric Collimation.	Setting of Micrometer.	Correction for Collimation and Diurnal Aberration.	
			Lamp W.	Lamp E.				Lamp W.	Lamp E.
1881.	r	r	s	s	1881.	r	r	s	s
Aug. 20	9·388	9·400	+0·025	−0·065	Sept. 14	9·407	9·400	−0·046	+0·006
21	9·391	9·400	+0·014	−0·054	15	9·417	9·400	−0·084	+0·044
23	9·386	9·400	+0·033	−0·073	18	9·414 9·416	9·400	−0·076	+0·036
24	9·397	9·400	−0·009	−0·031	19	9·416 9·414	9·400	−0·076	+0·036
25	9·407	9·400	−0·046	+0·006	22	9·400	9·400	−0·020	−0·020
26	9·393	9·400	+0·006	−0·046	23	9·404 9·401	9·400	−0·028	−0·012
27	9·406 9·405	9·400	−0·043	+0·003	24	9·406	9·400	−0·043	+0·003
29	9·363 9·367	9·400	+0·119	−0·159	25	9·406	9·400	−0·043	+0·003
Sept. 2	9·373	9·400	+0·082	−0·122	26	9·404	9·400	−0·035	−0·005
3	9·380	9·400	+0·055	−0·095	27	9·406	9·400	−0·043	+0·003
4	9·383	9·400	+0·044	−0·084	28	9·398 9·402	9·400	−0·020	−0·020
13	9·407	9·400	−0·046	+0·006					

SECTION VII.—TABLE 2.

DETERMINATION OF LEVEL ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.	Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s		1881.		div.	s	
August 20	E.	−0·48	−0·017		August 26	W.	−1·99	−0·133	
	E.	−1·33	−0·069*			W.	−0·69	−0·054*	
	W.	+0·30	+0·006			E.	−1·70	−0·092	
	W.	+1·19	+0·060*			E.	−3·11	−0·178*	
	W.	+3·15	+0·180			E.	−1·99	−0·109	
	W.	+2·01	+0·111*			E.	−3·74	−0·216*	
						W.	−2·16	−0·144	
21	W.	+0·83	+0·038			W.†	+1·63	+0·087	
	W.	+1·30	+0·067						
	E.	+0·36	+0·034		27	W.	−1·51	−0·104	
	E.	−1·06	−0·053*			W.	−1·23	−0·086	
						E.	−2·63	−0·148	
23	W.	+0·19	−0·002			E.	−3·84	−0·222*	
	W.	+0·73	+0·032						
	E.	−0·54	−0·021		28	E.	+3·41	+0·220	
	E.	−2·03	−0·111*			E.	+2·69	+0·176	

† Different Axis Lamps were used between this determination.

Digitized by Google

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	°
August 29	E.	+1·95	+0·131	
	E.	+1·08	+0·077*	
	W.	+2·00	+0·110	
	W.	+3·13	+0·179*	
	W.	+3·85	+0·222	
	W.	+3·81		
	E.†	+2·76	+0·180	
	E.	+0·98	+0·072	
September 2	E.	+2·25	+0·149	
	E.	−0·86	−0·040*	
	W.	+0·90	+0·043	
	W.	+2·65	+0·150*	
	Level altered.			
3	E.	−4·81	−0·281	
	E.	−5·86	−0·345*	
	W.	−0·86	−0·064	
	W.	+1·40	+0·073*	
	Level altered.			
13	W.	−0·66	−0·043	91 F.
	W.	−0·34		89
	E.	−1·46	−0·077	
	E.	−3·40	−0·195*	
14	W.	+0·03	−0·007	88
	W.	+0·14		
15	W.	−0·60	−0·031	86
	W.	−0·03		86
	E.	−0·63	−0·026	86
	E.	−1·70	−0·092*	88
18	W.	−0·09	−0·010	90
	W.	+0·15		90
	E.	−0·49	−0·018	90
	E.	−1·75	−0·095*	88
	E.	−1·39	−0·073	86
	E.	−3·00	−0·171*	88
	W.	−2·23	−0·148	
	W.	−0·06	−0·016*	87
19	W.	−0·47	−0·041	92
	W.	+0·50	+0·019*	90
	E.	−0·40	−0·012	89
	E.	−1·94	−0·106*	89
	E.	−1·85	−0·121	86
	E.	−2·51		85
	W.	+0·81	+0·025	85
	W.	+0·43		85

Date.	Position of Lamp.	Uncorrected Reading.	Level Error, including Correction for Pivot Error.	Temperature.
1881.		div.	s	°
September 22	W.	−0·40	−0·041	90 F.
	W.	−0·57		90
	E.	−0·99	−0·048	90
	E.	−2·15	−0·119*	
23	E.	−1·88	−0·103	89
	E.	−2·86	−0·162*	87
	W.	−1·85	−0·125	87
	W.	−0·46	−0·040*	87
	W.	−0·41	−0·020	85
	W.	+0·16		84
	E.	−1·15	−0·058	84
	E.	−2·39	−0·134*	85
24	E.	−0·76	−0·034	88
	E.	−1·60	−0·085*	88
	W.	−0·96	−0·068	89
	W.	+0·40	+0·012*	87
25	W.	−0·12	0·000	86
	W.	+0·48		86
	E.	−0·09	−0·025	88
	E.	−1·11		88
26	E.	−2·20	−0·116	86
	E.	−2·00		86
	W.	−0·83	−0·042	86
	W.	−0·16		87
27	E.	−0·89	−0·042	87
	E.	−1·86	−0·101*	87
	W.	−1·21	−0·086	
	W.	−0·30	−0·030*	
28	E.	−1·75	−0·105	86
	E.	−2·10		88
	W.	−1·49	−0·103	88
	W.	+0·24	+0·002*	87
	W.	+0·84	+0·046	87
	W.	+1·08		86
	E.	+0·03	+0·014	85
	E.	−1·13	−0·057	86

† Different Axis Lamps were used between this determination.

Digitized by Google

SECTION VII.—TABLE 3.

DETERMINATION OF AZIMUTH ERROR OF THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
			h m s	h m s	s
1881. August 20	E.	35 Draconis - -	17 54 20·14	17 54 47·14	−7·843
	W.	Cephei 51 S.P. - -	18 47 10·28	18 44 26·93	−7·738
	W.	Groomb. 2784 - -	19 2 32·60	19 2 57·94	−7·740
	W.	Polaris - - -	1 10 53·43	1 16 9·14	−7·805
	W.	40 Cassiopeiæ - -	1 28 56·52	1 29 9·28	−7·750
			Instrument altered in Azimuth.		
August 23	W.	Cephei 51 S.P. - -	18 45 27·59	18 44 28·28	−0·386
	W.	Groomb. 2784 - -	19 3 47·02	19 2 57·70	−0·580
	E.	64 Draconis - -	20 1 7·31	20 0 16·14	−0·428
	E.	κ Cephei - - -	20 13 46·29	20 12 55·92	−0·401
August 26	W.	Cephei 51 S.P. - -	18 45 14·56	18 44 29·53	−0·410
		Groomb. 2784 - -	19 3 32·67	19 2 57·46	
	E.	64 Draconis - -	20 0 52·10	20 0 16·05	−0·463
		κ Cephei - - -	20 13 30·70	20 12 55·75	
	E.	Bradley 6 -	0 10 13·75	0 9 38·38	−0·530
		Bradley 24 - -	0 20 16·41	0 19 41·98	
	W.	Cephei - - -	1 2 48·40	1 2 13·10	−0·495
		Polaris - - -	1 16 29·05	1 16 13·05	
August 27	W.	Draconis - -	18 23 50·40	18 23 13·32	−0·529
	E.	11 Cephei - - -	21 40 53·08	21 40 15·48	−0·551
August 29	E.	χ Draconis - -	18 23 54·41	18 23 13·18	−0·352
		Cephei 51 S.P. - -	18 45 19·91	18 44 30·75	
	W.	σ Draconis - -	19 33 18·95	19 32 37·83	−0·370
		λ Ursæ Minoris - -	19 43 26·06	19 43 1·40	
	W.	Bradley 2993 - -	22 23 27·16	22 22 49·65	−0·453
		31 Cephei - - -	22 33 37·41	22 32 56·05	
	E.	κ Cassiopeiæ - -	0 27 2·70	0 26 20·69	−0·464
Sept. 2	E.	76 Draconis - -	20 51 59·58	20 51 11·62	−0·357
		β Cephei - - -	21 28 0·83	21 27 11·91	
	W.	Bradley 3038 - -	22 48 51·51	22 48 5·13	−0·487
		The Level was altered here; and the Azimuth appears to have changed in consequence.			
Sept. 3	E.	β Cephei - - -	21 28 0·49	21 27 11·89	−1·318
		31 Cephei - - -	22 33 44·05	22 32 56·04	
	W.	50 Cassiopeiæ - -	1 54 14·64	1 53 26·10	−1·341

Digitized by Google

Date.	Position of Lamp.	Name of Star.	Observed Time corrected for Collimation and Level.	Tabular Apparent Time of Transit.	Azimuth Error.
1881.			h m s	h m s	
Sept. 13	W.	λ Ursæ Minoris - -	19 42 14·92	19 42 45·43	s
		64 Draconis - -	20 0 58·94	20 0 15·41	−1·480
		κ Cephei - -	20 13 34·55	20 12 54·48	
	E.	76 Draconis - -	20 51 46·81	20 51 10·50	−1·514
		77 Draconis - -	21 8 35·10	21 7 55·40	
Sept. 18	W.	73 Draconis - -	20 33 46·39	20 33 6·49	−1·460
		76 Draconis - -	20 51 44·79	20 51 8·63	
	E.	11 Cephei - - -	21 40 56·26	21 40 14·95	−1·550
		24 Cephei - - -	22 8 17·34	22 7 36·25	
	E.	Polaris - - -	1 16 4·83	1 16 26·59	−1·594
	W.	36 Hev. Cassiop. -	2 27 34·65	2 26 54·22	−1·660
		Cephei - - -	2 51 9·96	2 50 32·65	
Sept. 19	W.	73 Draconis - -	20 33 46·17	20 33 6·42	−1·537
		76 Draconis - -	20 51 44·67	20 51 9·80	
	E.	24 Cephei - - -	22 8 17·00	22 7 36·22	−1·672
		Bradley 2993 - -	22 23 12·25	22 22 48·17	
	E.	Cephei - - -	2 51 10·56	2 50 32·75	−1·522
	W.	Camelopardi - -	3 38 38·86	3 37 57·86	−1·568
Sept. 22	W.	73 Draconis - -	20 33 45·61	20 33 6·19	−1·546
		76 Draconis - -	20 51 43·82	20 51 9·43	
	E.	11 Cephei - - -	21 40 55·40	21 40 14·81	−1·586
		24 Cephei - - -	22 8 16·47	22 7 36·13	
Sept. 23	E.	77 Draconis - -	21 8 32·08	21 7 54·71	−1·620
		β Cephei - - -	21 27 51·63	21 27 11·24	
	W.	24 Cephei - - -	22 8 15·99	22 7 36·09	−1·690
		Bradley 2993 - -	22 23 11·25	22 22 47·69	
	W.	Cephei - - -	1 2 51·46	1 2 14·89	−1·580
		Polaris - - -	1 16 6·37	1 16 28·23	
	E.	50 Cassiopeiæ - -	1 54 7·08	1 53 27·18	−1·585
		36 Hev. Cassiop. - -	2 27 34·43	2 26 54·52	
Sept. 26	E.	77 Draconis - -	21 8 32·03	21 7 54·47	−1·580
		β Cephei - - -	21 27 50·92	21 27 11·11	
	W.	24 Cephei - - -	22 8 15·09	22 7 36·00	−1·720
		Bradley 2993 - -	22 23 10·06	22 22 47·28	
Sept. 28	E.	β Cephei - - -	21 27 50·72	21 27 11·02	−1·612
		11 Cephei - - -	21 40 53·76	21 40 14·57	
	W.	31 Cephei - - -	22 33 34·11	22 32 55·57	−1·770
		Bradley 3038 - -	22 48 35·96	22 48 5·15	
	W.	36 Hev. Cassiop. - -	2 27 33·55	2 26 54·78	−1·676
		Cephei - - -	2 51 9·13	2 50 33·81	
	E.	Camelopardi - -	3 38 38·00	3 37 58·48	−1·526
		Piazzi III–160 - -	3 51 1·87	3 50 27·34	

Digitized by Google

SECTION VII.—TABLE 4.

OBSERVATIONS WITH THE SMALL TRANSIT AT ADEN BY MR. FINLAY.

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 20	γ Ophiuchi - -	E.	17 42 4·76	5	3·29	59·16	− 4·13
	Lalande 32633 - -		17 46 0·30	5	58·31	54·10	− 4·21
	B.A.C. 6060 - -		17 49 7·90	5	3·44	59·21	− 4·23
	Lalande 33262 - -		18 2 45·60	5	44·90	40·51	− 4·39
	μ^1 Sagittarii - -		18 6 52·32	5	47·50	43·12	− 4·38
	θ Serpentis - -	W.	18 50 28·22	5	27·10	22·09	− 5·01
	B.A.C. 6488 - -		18 54 58·68	5	54·94	49·83	− 5·11
	15 Aquilæ - - -		18 58 51·98	5	49·78	44·78	− 5·00
	d Sagittarii - -		19 10 54·38	5	50·14	44·80	− 5·34
	υ Sagittarii - -		19 15 8·26	5	4·44	59·13	− 5·31
Aug. 23	B.A.C. 6488 - -	W.	18 55 41·42	5	41·25	49·80	−51·45
	15 Aquilæ - - -		18 59 36·22	5	36·13	44·75	−51·38
	d Sagittarii - -		19 11 36·66	5	36·47	44·77	−51·70
	υ Sagittarii - -		19 15 50·92	5	50·74	59·11	−51·63
	ν Aquilæ - - -		19 21 21·66	5	21·60	29·93	−51·67
	η Aquilæ - - -	E.	19 47 20·80	5	20·60	28·76	−51·84
	β Aquilæ - - -		19 50 24·12	5	23·95	32·09	−51·86
	63 Sagittarii - -		19 56 15·38	5	15·06	23·04	−52·02
	ξ Capricorni - -		20 6 44·86	5	44·52	52·51	−52·01
Aug. 26	B.A.C. 6347 - -	W.	18 32 29·04	5	28·70	52·03	−36·67
	B.A.C. 6367 - -		18 37 43·38	5	43·14	6·49	−36·65
	B.A.C. 6488 - -		18 55 27·00	4	26·73	49·77	−36·96
	15 Aquilæ - - -		18 59 21·87	3	21·68	44·72	−36·96
	d Sagittarii - -		19 11 22·00	5	21·72	44·74	−36·98
	51 Aquilæ - - -	E.	19 44 55·34	4	55·00	18·26	−36·74
	η Aquilæ - - -		19 47 5·81	3	5·56	28·75	−36·81
	β Aquilæ - - -		19 50 9·20	5	8·98	32·08	−36·90
	63 Sagittarii - -		19 56 0·48	5	0·10	23·02	−37·08
	ξ Capricorni - -		20 6 29·74	5	29·34	52·49	−36·85
	ω Piscium - -	E.	23 53 53·73	3	53·51	16·29	−37·22
	2 Ceti - - -		23 58 20·38	5	19·93	42·77	−37·16
	d Piscium - -		0 15 10·12	5	9·86	32·82	−37·04
	13 Ceti - - -		0 29 49·16	5	48·77	11·46	−37·31
	15 Ceti - - -		0 32 41·16	5	40·79	3·59	−37·20
	26 Ceti - - -	W.	0 58 23·04	5	22·83	45·65	−37·18
	39 Ceti - - -		1 11 15·22	5	15·03	37·78	−37·25
	48 Ceti - - -		1 24 35·00	5	34·74	57·34	−37·40
	50 Ceti - - -		1 30 51·92	5	51·74	14·40	−37·34
Aug. 27	B.A.C. 6111 - -	W.	17 58 36·14	5	35·66	56·92	−38·74
	Lalande 33262 - -		18 2 19·16	5	18·98	40·41	−38·57
	μ^1 Sagittarii - -		18 7 22·12	5	21·67	43·04	−38·63
	Washington 6386 -		18 14 6·64	5	6·45	27·88	−38·57
	21 Sagittarii - -		18 18 59·12	5	58·68	20·06	−38·62
	B.A.C. 7649 - -	E.	21 52 49·66	5	49·16	10·16	−39·00
	e Aquarii - - -		22 4 59·64	5	59·22	20·16	−39·06
	θ Aquarii - - -		22 11 17·06	5	16·67	37·65	−39·02
	γ Aquarii - - -		22 16 14·32	5	13·98	34·95	−39·03
Aug. 29	B A.C. 6324 - -	E.	18 29 12·30	5	12·11	29·58	−42·53
	B.A,C. 6347 - -		18 32 34·76	5	34·49	51·98	−42·51
	B.A.C. 6367 - -		18 37 49·08	5	48·89	6·46	−42·43
	θ Serpentis - -		18 51 4·57	3	4·45	21·98	−42·47
	B.A.C. 6488 - -		18 55 32·56	5	32·30	49·74	−42·56

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Aug. 29	B.A.C. 6694	W.	19 28 9·90	5	9·90	27·51	−42·39
	η Aquilæ		19 47 10·99	4	11·18	28·72	−42·46
	Aquilæ		19 50 14·32	5	14·55	32·04	−42·51
	63 Sagittarii		19 56 5·54	5	5·65	23·00	−42·65
	τ Aquilæ		19 59 5·88	5	6·13	23·54	−42·59
	20 Piscis Australis	W.	22 39 48·04	5	48·05	5·27	−42·78
	τ Aquarii		22 44 4·54	5	4·65	21·87	−42·78
	λ Aquarii		22 47 11·36	5	11·53	28·75	−42·78
	ρ Pegasi		22 50 1·14	5	1·44	18·59	−42·85
	δ Sculptoris	E.	23 43 31·14	5	30·74	47·92	−42·82
	22 Piscium		23 46 39·48	5	39·38	56·56	−42·82
	ω Piscium		23 53 59·13	4	59·05	16·33	−42·72
	2 Ceti		23 58 26·01	2	25·70	42·82	−42·88
	Lalande 257		0 12 17·66	5	17·31	34·54	−42·77
Sept. 2	ν Aquarii	E.	21 4 1·21	3	1·06	11·10	−49·96
	ζ Capricorni		21 20 47·36	3	47·07	57·07	−50·00
	B.A.C. 7649		21 53 0·68	5	0·33	10·17	−50·16
	B.A.C. 7665		21 56 33·74	5	33·40	43·38	−50·02
	ι Aquarii		22 0 55·46	5	55·14	5·08	−50·06
	2 Piscium	W.	22 54 15·72	5	15·78	25·90	−49·88
	h^1 Aquarii		22 59 51·92	5	51·92	1·83	−50·09
	c^2 Aquarii		23 4 0·74	5	0·64	10·54	−50·10
	59 Pegasi		23 6 37·98	5	38·16	48·10	−50·06
Sept. 3	ι Aquarii	E.	22 0 57·98	5	56·98	5·08	−51·90
	π Aquarii		22 20 8·92	5	8·23	16·40	−51·83
	σ Aquarii		22 25 18·20	5	17·24	25·37	−51·87
	υ Aquarii		22 29 8·62	5	7·43	15·58	−51·85
	34 Ceti	W.	1 6 36·02	4	36·67	44·50	−52·17
	39 Ceti		1 11 30·48	5	30·13	37·94	−52·19
	ξ Piscium		1 48 20·06	3	19·91	27·75	−52·16
	61 Ceti		1 58 39·10	5	38·89	46·66	−52·23
Sept. 13	η Aquilæ	W.	19 47 15·26	5	14·86	28·54	−46·32
	β Aquilæ		19 50 18·40	5	18·14	31·88	−46·26
	63 Sagittarii		19 56 9·94	5	9·16	22·84	−46·32
	ξ Capricorni		20 6 39·48	5	38·73	52·33	−46·40
	η Capricorni	E.	20 58 29·72	5	28·74	42·46	−46·28
	ν Aquarii		21 3 58·10	5	57·34	11·03	−46·31
	16 Aquarii		21 15 41·10	5	40·49	54·28	−46·21
	ζ Capricorni		21 20 44·36	5	43·26	57·01	−46·25
Sept. 18	ϵ Aquarii	W.	20 42 4·34	5	3·68	18·26	−45·42
	ω Capricorni		20 45 34·36	4	33·21	47·75	−45·46
	ν Aquarii		21 3 57·10	5	56·39	10·99	−45·40
	α Equulei		21 10 42·24	5	41·95	56·59	−45·36
	41 Capricorni	E.	21 36 5·06	5	4·07	18·74	−45·33
	Lalande 42574		21 45 55·96	5	55·09	9·83	−45·26
	B.A.C. 7628		21 48 47·56	5	47·08	1·77	−45·31
	B.A.C. 7649		21 52 56·40	5	55·44	10·13	−45·31
	50 Ceti	E.	1 31 0·98	5	0·11	14·86	−45·25
	ν Piscium		1 36 4·26	5	3·95	18·73	−45·22
	o Piscium		1 39 56·56	5	56·34	11·04	−45·30
	ξ Piscium		1 48 13·66	5	13·27	28·05	−45·22

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 18	ρ Ceti	W.	2 21 2·12	5	1·18	16·05	−45·13
	δ Ceti		2 34 12·82	5	12·28	27·16	−45·12
	μ Ceti		2 39 20·38	5	20·14	34·94	−45·20
	Lalande 5211		2 43 3·84	5	2·96	17·77	−45·19
	τ^2 Eridani		2 46 28·48	5	27·36	42·17	−45·19
Sept. 19	ρ Capricorni	W.	20 22 51·70	5	53·76	8·67	−45·09
	Washington 8892		20 25 14·40	4	13·54	28·52	−45·02
	Lalande 40029		20 38 34·68	5	34·38	49·15	−45·23
	ϵ Aquarii		20 42 4·14	5	3·46	18·25	−45·21
	ω Capricorni		20 45 34·08	5	32·88	47·73	−45·15
	B.A.C. 7665	E.	21 56 29·14	5	28·25	43·34	−44·91
	ι Aquarii		22 0 50·94	5	50·16	5·04	−45·12
	e Aquarii		22 5 6·02	5	5·30	20·15	−45·15
	γ Aquarii		22 16 20·34	4	19·88	34·97	−44·91
	π Aquarii		22 20 1·76	5	1·37	16·39	−44·98
	δ Ceti	E.	2 34 12·58	5	12·16	27·18	−44·98
	μ Ceti		2 39 20·06	5	19·89	34·96	−44·93
	Lalande 5211		2 43 3·38	5	2·64	17·80	−44·84
	τ^2 Eridani		2 46 28·26	5	27·27	42·19	−45·08
	o Tauri	W.	3 19 14·00	5	13·83	28·76	−45·07
	Lalande 6476		3 24 48·30	5	47·54	2·54	−45·00
	τ^5 Eridani		3 29 21·46	5	20·43	35·38	−45·05
	20 Eridani		3 31 41·68	5	40·78	55·68	−45·10
Sept. 22	ϵ Aquarii	W.	20 42 3·58	5	2·91	18·21	−44·70
	ω Capricorni		20 45 33·60	5	32·42	47·69	−44·73
	19 Capricorni		20 48 54·28	5	53·38	8·74	−44·64
	η Capricorni		20 58 28·05	4	27·09	42·36	−44·73
	ν Aquarii		21 3 56·38	5	55·66	10·95	−44·71
	41 Capricorni	E.	21 36 4·50	5	3·39	18·71	−44·68
	Lalande 42574		21 45 55·34	5	54·37	9·80	−44·57
	B.A.C. 7628		21 48 46·96	5	46·37	1·74	−44·63
	B.A.C. 7649		21 52 55·84	5	54·78	10·10	−44·68
Sept. 23	ν Aquarii	E.	21 3 56·13	3	55·31	10·94	−44·37
	16 Aquarii		21 15 39·29	4	38·64	54·19	−44·45
	ζ Capricorni		21 20 42·36	5	41·19	56·92	−44·27
	Lalande 41765		21 24 8·80	5	7·72	23·31	−44·41
	ξ Aquarii		21 32 14·40	5	13·63	29·33	−44·30
	ι Aquarii	W.	22 1 0·38	5	49·45	5·02	−44·43
	e Aquarii		22 5 5·40	5	4·55	20·13	−44·42
	θ Aquarii		22 11 22·75	4	22·02	37·63	−44·39
	γ Aquarii		22 16 19·84	5	19·31	34·95	−44·36
	26 Ceti	W.	0 58 30·82	4	30·44	46·10	−44·34
	39 Ceti		1 11 23·08	5	22·59	38·25	−44·34
	47 Ceti		1 21 48·72	5	47·95	3·54	−44·41
	50 Ceti		1 31 0·12	5	59·28	14·93	−44·35
	ν Piscium		1 36 3·30	5	3·03	18·80	−44·23
	67 Ceti	E.	2 11 52·06	5	51·41	7·05	−44·36
	B.A.C. 737		2 17 55·30	5	54·14	9·80	−44·34
	ρ Ceti		2 21 1·36	5	0·54	16·15	−44·39
	δ Ceti		2 34 12·04	5	11·54	27·26	−44·28
Sept. 26	η Capricorni	E.	20 58 27·26	5	26·23	42·32	−43·91
	ν Aquarii		21 3 55·68	5	54·89	10·90	−43·99
	16 Aquarii		21 15 38·60	5	37·99	54·16	−43·83
	ζ Capricorni		21 20 41·86	5	40·75	56·89	−43·86

Digitized by Google

Date.	Name of Star.	Position of Lamp.	Transit reduced to Centre Wire.	No. of Wires.	Seconds of Clock Time of True Transit.	Seconds of Tabular Apparent R.A.	Clock Slow.
1881.			h m s		s	s	s
Sept. 26	ι Aquarii - -	W.	22 0 49·70	5	48·81	5·00	−43·81
	e Aquarii - -		22 5 4·80	5	3·98	20·11	−43·87
	γ Aquarii - -		22 16 19·20	5	18·68	34·93	−43·75
	π Aquarii - -		22 20 0·54	5	0·10	16·36	−43·74
	υ Aquarii - -		22 29 0·52	5	59·41	15·56	−43·85
Sept. 28	41 Capricorni - -	E.	21 36 3·30	5	2·11	18·64	−43·47
	Lalande 42574 - -		21 45 54·24	5	53·20	9·75	−43·45
	B.A.C. 7628 - -		21 48 45·84	5	45·22	1·69	−43·53
	B.A.C. 7649 - -		21 52 54·66	5	53·54	10·05	−43·49
	υ Aquarii - -	W.	22 29 0·15	4	59·00	15·54	−43·46
	τ Aquarii - -		22 43 36·24	5	5·35	21·91	−43·44
	2 Piscium - -		22 54 9·78	5	9·37	25·94	−43·43
	h^1 Aquarii - -		22 59 46·00	5	45·34	1·88	−43·46
	δ Ceti - - -	W.	2 34 11·12	5	10·77	27·36	−43·41
	τ^2 Eridani - - -		2 46 26·88	5	25·88	42·38	−43·50
	ρ^3 Eridani - - -		2 59 14·02	5	13·44	29·96	−43·48
	Lalande 5759 - -		3 1 28·40	5	27·88	44·53	−43·35
	20 Eridani - - -	E.	3 31 40·16	5	39·32	55·90	−43·42
	22 Eridani - - -		3 35 32·74	5	32·22	48·91	−43·31
	τ^6 Eridani - - -		3 42 31·82	5	30·79	47·29	−43·50
	30 Eridani - - -		3 47 36·82	5	36·28	52·94	−43·34

Digitized by Google

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 3.

TELEGRAPHIC DETERMINATIONS

OF THE LONGITUDES OF

LOURENÇO MARQUES (DELAGOA BAY), MOZAMBIQUE, AND ZANZIBAR,

AND THE

LONGITUDE OF QUILIMANE.

BY

W. H. FINLAY, B.A., *Chief Assistant, Royal Observatory, Cape of Good Hope.*

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY, IN OBEDIENCE TO HER MAJESTY'S COMMAND.

Digitized by Google

Digitized by Google

Telegraphic Longitudes of LOURENÇO MARQUES (DELAGOA BAY), MOZAMBIQUE, and ZANZIBAR, and Longitude of QUILIMANE.

A short account of the results of the observations made for determining these longitudes has been given in the Monthly Notices of the R.A.S., Vol. xliii., 9; but it seems desirable that more details should be given, at least in the case of the altazimuth. A full description of this instrument is given on page 18 of the British observations of the Transit of Venus, 1874. The Sextant was confined to observations of the Sun; it was an 8-inch one, by Dollond, and was in good adjustment; observations at about the same altitude as those actually made during the expedition were made before I left the Cape, and showed that no sensible correction was required to the resulting local time for excentricity. The Sextant was used at Delagoa Bay, Quilimane, and Mozambique (first visit); the altazimuth at Zanzibar and Mozambique (second visit). I had three chronometers with me, viz., Cribb, 722, Parkinson and Bouts, 801 (both mean time), and Dent, 1589 (sidereal). No temperature coefficients were supplied with the chronometers, and no attempt has been made to trace their daily variation, as they had to undergo several changes of position. They were compared among themselves frequently, especially before and after any observations. The sidereal chronometer was always used for observing. From the comparisons and the exchanges of signals errors were found for the chronometers at intervals, and a rate adopted for the intervening time; these rates of the mean time chronometers were then used for checking the rate of the observing chronometer on any day of observation. The interval, however, between the observations and the exchange of signals was never more than a few hours.

The stations of the Eastern and South African Telegraph Company on the East Coast are Durban, Delagoa Bay, Mozambique, and Zanzibar, and every facility was given by the Superintendents at these places for exchanging signals through the cable. At Durban there is a short line connecting the Government Telegraph Office (land-line) with the cable office, and there is direct communication between the Government Office and the Cape Observatory. On my way to Aden the signals from my end of the cable were received at Durban and sent on to the Observatory by H. McEwen, Esq., of the Eastern Telegraph Company's staff. Some delay must necessarily occur in such translation, and it is by no means certain that the delay is the same when the signals are received at the intermediate station on the mirror galvanometer as when received on the Morse instrument; but it will be seen from the results that the delay was very short. On my return journey, Mr. Maclear, Second Assistant at the Cape Observatory, occupied the Durban longitude station, and my signals were exchanged with Durban only. Whilst engaged at Durban in determining my personal equation with Mr. Maclear in observing mirror signals, as related in the account of the Cape longitude determination, Mr. McEwen and I compared a large number of signals, and we found that the difference of our estimates of the start of the spot of light was insensible.

Digitized by Google

The cable does not touch at Inhambane or Quilimane, so that I had to trust to my chronometers for any determinations at these places; but the interval for which the rate had to be assumed was only a few days.

The stay of the British India steamers at Inhambane, Quilimane, and Mozambique never exceeded twenty-four hours. There were no boats for hire at these places, and we sometimes arrived at night, so that the time at my disposal was generally short. At Zanzibar the steamers usually stopped two days; I was able to land the altazimuth there, and also at Mozambique on the return journey.

SECTION II.

OBSERVATIONS AT THE CAPE.

The Observations were made with the Transit Circle, and the Hut Clock was compared with the Transit Clock by chronometers; the signals were sent from the Hut Clock. It is scarcely necessary to give the details of these observations, as they were made by the regular observers in the usual way. The results for clock-error are as follows:—

Date.	Time by Hut Clock.	Correction to Transit Clock.	Correction to Hut Clock.
1881.	h m	s	s
July 12	15 5	−56·22	− 1·97
13	16 47	−57·10	−61·28
	19 46	−57·24	−61·20
28	16 18	−12·06	−33·82
	20 19	−12·20	−33·71
29	18 32	−12·86	−33·32
	23 48	−13·05	−33·24

SECTION III.

OBSERVATIONS AT DURBAN.

The observations at Durban were made with the small Transit at the "longitude station." The collimation error was determined several times, and was very constant during the

Digitized by Google

period over which these observations extend. The following table gives the level and azimuthal errors observed :—

Date.	Position of Lamp.	Level Error.	Azimuthal Error.	Determining Stars for Azimuthal Error.
1881.		s	s	
October 17	E.	−0·286	−2·258	ζ Octantis S.P. and Lac. 8798.
	W.	−0·288	−2·340	Lac. 248 and ι Octantis S.P.
18	W.	−0·205	−2·252	ζ Octantis S.P. and Lac. 8798.
	E.	−0·306	−2·352	Lac. 9464 and Lac. 4865 S.P.
19	E.	−0·310	−2·325	Lac. 4232 S.P. and C. Octantis.
	W.	−0·320	−2·288	Lac. 4865 S.P. and Lac. 9563.
*21	W.	−0·128	−2·277	α Trianguli Australis.
24	W.	−0·060	−4·539	β Centauri.
25	W.	—	−4·354	α Triang. Aust.
	W.	0·000	−4·361	β Centauri.
29	E.	−0·174	−4·299	Lac. 9464 and Lac. 4865 S.P.
	W.	−0·137	−4·258	Lac. 9745 and ι Octantis S.P.
November 9	W.	−0·239	−4·310	Lac. 4991 S.P. and Lac. 9745.
	E.	−0·256	−4·224	Lac. 248 and Lac. 5325 S.P.

* On October 21 the Azimuth was altered, but the screw was apparently turned the wrong way.

and with the above values the following determinations of clock-error were obtained :—

Date.	Lamp.	Mean of Clock Times.	No. of Time Stars.	Correction to Clock.	Daily Rate.
1881.		h m		s	s
October 17	E.	7 22	4	−20·31	
	W.	10 54	4	−20·17	
					+0·87
18	W.	7 18	4	−19·44	
	E.	10 4	4	−19·33	
					+0·97
19	E.	8 18	4	−18·42	
	W.	10 3	4	−18·38	
					+0·83
21	W.	2 22	1	−16·97	
					+0·70
25	W.	1 8	2	−14·24	
					(+0·46)
	W.	23 50	1	−13·81	
					+0·78
29	E.	9 14	3	−11·10	
	W.	9 52	2	−11·21	
November 8	E.	8 36	2	−58·34	
	W.	9 19	2	−58·13	
					+0·72
9	W.	8 32	2	−57·48	
	E.	9 15	2	−57·55	

There are no observations on Oct. 23, and unfortunately the time-determinations immediately on each side of this date are weak; but the clock seems to have been going well, and its daily rate about this time could not have differed much from +0^{s}·75.

Digitized by Google

SECTION IV.

COMPARISONS OF CHRONOMETERS.

Date.	Approx. Cape Mean Time.	Dent (Sidereal).	Cribb.	Parkinson and Bouts.	Thermometer.
1881.	h	h m s	h m s	h m s	°
July 2	0	6 35 18	20 21 47·8		
		6 34 33		20 38 4·8	
12	2	10 6 5	23 13 14·5		69·0
		10 6 53		23 31 14·9	
,,	20	4 22 55	17 27 7·5		70·0
		4 23 38		17 45 4·0	
13	3	10 23 3		23 43 31·5	69·0
		10 26 48	23 30 2·0		
	11	18 52 48	7 54 40·5		
	20	4 48 11		18 5 42·0	69·0
		4 50 29	17 50 45·0		
16	21	5 52 42		18 58 26·5	72·4
		5 55 49·5	18 44 17·0		
20	18	1 49 24		14 40 15·5	
		1 51 38	14 25 10·5		
	20	4 0 23		16 50 53·5	
		4 1 47	16 34 58·5		
22	19	2 39 4		15 22 0·5	79·0
		2 41 3	16 6 38·5		
23	4	12 11 15	0 35 17·0		79·0
		12 13 9		0 54 31·5	
	18	1 34 15	1 56 6·0		74·0
		1 35 17		2 14 29·0	
24	3	10 15 37	22 36 3·5		78·4
		10 16 44		22 54 33·0	
26	19	3 2 44	15 12 37·5		80·0
		3 3 37		15 30 54·0	
28		12 28 55	0 38 23·0		
		12 34 5		0 55 57·0	
		5 11 35	17 13 20·5		79·0
		5 12 52		17 32 3·0	
29		10 43 3		23 1 21·0	79·7
		10 46 56	22 47 47·5		
		4 12 23	16 10 27·0		79·0
		4 14 10		16 29 39·5	
At Aden—Chronometers ran down.					
October 4		14 39 48		19 31 40·4	
		14 40 37	22 46 45·7		
17		0 29 58		4 31 8·0	81·0
		0 31 10	7 46 16·0		
		15 46 42		19 45 15·4	81·0
		15 47 51	23 0 19·5		

Digitized by Google

Date.	Approx. Cape Mean Time.	Dent (Sidereal).	Cribb.	Parkinson and Bouts.	Thermometer.
	h	h m s	h m s	h m s	°
October 22	3	0 10 15		4 51 10·7	81·0
		0 11 17	7 6 1·5		
	20	17 47 56		21 25 51·0	82·5
		17 50 20	0 42 2·5		
23		18 43 50	1 31 17·5		81·0
		18 44 21		22 18 2·5	
24		16 29 13		19 59 12·0	80·0
		16 29 52	23 13 35·5		
November 3	7	4 43 47		7 34 46·0	71·5
		4 45 54	10 50 25·5		
9	20	18 29 19		20 53 16·0	
		18 32 18	0 9 40·5		
10	18	17 18 35	22 47 54·5		77·0
		17 20 7		19 36 0·0	

Determinations of the error of Chronometer Dent on Cape Sidereal Time were obtained from comparisons with the Transit Clocks at Durban and Aden, and from the exchanges of signals :—

Date.	C.M.T.	Error.	
1881.	h		h m s
July 1	22	Dent slow	0 10 4·9
13	11	„ „	0 10 40·9
28	10	„ „	0 11 12·1
29	$14\frac{1}{2}$	„ „	0 11 17·6
October 4	20	Dent fast	6 37 19·0
17	$8\frac{1}{2}$	„ „	6 39 34·0
23	$17\frac{3}{4}$	„ „	6 40 34·4
November 4	12	„ „	6 42 53·8
9	18	„ „	6 43 59·6

From these errors, combined with the comparisons given above, the following table of average rates of the standard chronometers was formed :—

Digitized by Google

RATES OF STANDARD CHRONOMETERS.

Approximate Cape Mean Time.	Interval.	Cribb.	P. and B.	——
July 1881. d h	d	s	s	
1 21				
	11·38	+0·11	+1·14	At Delagoa Bay.
13 6				
	15·75	+0·11	+0·84	From Delagoa Bay to Zanzibar.
29 0				
October 4 19				
	12·69	−0·47	+1·14	From Aden to Zanzibar.
17 12				
	6·43	+0·12	+1·66	From Zanzibar to Mozambique.
23 22				
	10·47	+0·28	+1·68	From Mozambique to Delagoa Bay.
November 3 7				
	6·55	+0·61	+1·22	At Delagoa Bay.
9 21				

These average rates were used for determining the error of Dent at Quilimane and at Mozambique (first visit), and for checking its rate at the other places between the times of observation and of exchange of signals.

SECTION V.

SEXTANT OBSERVATIONS.

Delagoa Bay.

The observations here were made at the flagstaff in front of the telegraph office. This is a well marked position on the top of the hill at Punta Vermelha (Reuben Point).

Latitude.

Date.	No. of Observations.	Observed.	Adopted.
1881.			° ′ ″
July 6	8	− 25° 58′ 4″	
7	6	− 25 58 11	− 25 58 4
13	12	− 25 57 55	

Digitized by Google

Time.

The following determinations of the error of the observing chronometer on local time were made near the time of the exchange of signals:—

Date.	Approx. Mean Time.	No. of Observations.	Time by Chronometer.	Sun's Hour Angle.	Correction to Chronometer.	Coefficient of $d\phi$.
1881.	h		h m	h m	h m s	
July 10	21	12	3 45	2 31	+ 1 6 59·01	+ 0·086
11	3	6	10 3	3 46	+ 1 7 1·42	·054
11	21	4	3 15	3 4	+ 1 7 2·13	·068
12	3	14	9 47	3 27	+ 1 7 4·29	·060
12	21	10	3 2	3 21	+ 1 7 4·10	·062
13	3	14	10 0	3 36	+ 1 7 7·08	·057
13	21	12	3 22	3 5	+ 1 7 9·33	+ 0·067

The last column gives the factor by which a change $d\phi$ of latitude must be multiplied in order to derive the corresponding change in the chronometer correction.

With these errors and the chronometer comparisons we have—

Local Mean Time.	Cribb Slow.	P. and B. Slow.
1881. d h m	h m s	h m s
July 12 3 51	4 37 33·82	4 20 21·28
22 5	31·07	17·45
13 4 8	33·13	19·26
22 26	32·46	17·84

There seems to be a slight systematic difference between the results of the morning and afternoon observations, and the observation on July 12^d, 22^h stands out considerably; but taking the mean on each day, we have—

Local Mean Time.	Cribb Slow.	P. and B. Slow.
d h m	h m s	h m s
July 12 12 58	4 37 32·45	4 20 19·37
13 13 18	32·80	18·55

Signals were exchanged with the Cape on the night of July 13, with hand-translation by Mr. McEwen at Durban. The rule usually followed in exchanging signals was for the eastern station to send for 7 minutes, then the western for 15 minutes, and then the eastern again for 7 minutes. In this case both clock and chronometer were beating

Digitized by Google

sidereal time, and the means of all the signals have been taken. These give the following results:—

Delagoa Bay sending.				Cape sending.			
Del. B. Chron.		Cape Clock.		Del. B. Chron.		Cape Clock.	
h m s		h m s		h m s		h m s	
17 58 0·0	=	18 9 42·8		17 58 18·6	=	18 10 0·0	

Dent was compared with Cribb after the signals (Parkinson and Bout's seems unfortunately to have been overlooked), and found to be $1^h\ 7^m\ 8^s{\cdot}36$ slow at the time of the signals: whence difference of longitude—

h m s	h m s
= 0 56 26·80	= 0 56 28·20

therefore mean $= 0^h\ 56^m\ 27^s{\cdot}50$

and "loss of time" $= \frac{1^s{\cdot}40}{2} = 0^s{\cdot}70$.

Nov. 9.—Cloudy weather and rain prevented any observations on my return to Delagoa Bay until the day before I left. Signals were exchanged with Durban in the morning, and observations of the Sun made shortly afterwards. According to these observations (14 in number) Dent was $5^h\ 47^m\ 32^s{\cdot}8$ fast on local Sidereal Time at $17^h\ 39^m$ Chronometer Time. Signals had also been exchanged with Durban on November 4 for another purpose, and from these exchanges and the comparisons with the standards, it results that Dent was gaining $12^s{\cdot}6$ per day.

Signals.

Del. B. sending (one coincidence).				Durban sending (mean of three coincidences).			
Del. B. Chron.		Durban Clock.		Del. B. Chron.		Durban Clock.	
h m s		h m s		h m s		h m s	
16 6 0·0	=	18 55 13·0		15 54 32·17	=	18 43 46·67	
whence difference of longitude							
h m s				h m s			
= 0 6 15·14				= 0 6 15·62			

h m s

mean - - 0 6 15·38

and "loss of time" $= \frac{0^s{\cdot}48}{2} = 0^s{\cdot}24$.

Quilimane. (Latitude — 17° 52′ 23″.)*

July 20. The observations were made on the steps of the north-east side of the Custom House. The errors of the standard chronometers have been deduced from the

* This latitude was determined in 1884 by Capt. Aldrich, R.N., and the officers of H.M.S. "Fawn."

Digitized by Google

signals at Zanzibar on July 28 and 29, with the average rates given above. At the time of the second comparison of Dent with the standards (*i.e.*, after the observations), these latter differed $0^s{\cdot}86$ in giving Cape mean time,—the mean of the two has been adopted. These observations (18) make the longitude of my station—

$$1^h\ 13\ \ 35^s{\cdot}2 - {\cdot}042d\varphi \text{ East of the Cape.}$$

I had no time to make any latitude observations. In these and the previous observations for time both contacts and separations of the limbs were observed, and the mean of the resulting times taken. There is a discrepancy between the two resulting clock-errors of about $1^s{\cdot}15$. If contacts only be used, with the semi-diameter deduced from several measures, the preceding differences of longitude require to be diminished by $0^s{\cdot}6$.

MOZAMBIQUE (first visit). (Latitude = − 15° 1′ 50″.)

July 23. The observations were made in an open space among the trees in front of the telegraph office. The flagstaff in Sebastian Fort is 1,027 feet distant, and bears 74° 15′ East of North from this place.*

I exchanged signals with Mr. McEwen at Durban, but failure of the land-line and bad weather for the next day or two prevented his getting any exchange with the observatory. I have, therefore, deduced the errors of the standard chronometers as at Quilimane. These observations make my station—

$$1^h\ 29^m\ 4^s{\cdot}9 \text{ East of the Cape,}$$

the reduction in longitude to the flagstaff is $0^s{\cdot}67$.

The probable error of a time determination (say 10 to 15 observations) deduced from the discordances of the separate results from the mean is about $\pm\ 0^s{\cdot}25$.

SECTION VI.

ALTAZIMUTH OBSERVATIONS.

This instrument was the one used at Honolulu in the Transit of Venus Expedition, 1874. The values of the levels were carefully determined before I left the Cape, with the result that—

$$1^{\text{div.}} \text{ of level } ef = 1''{\cdot}808,$$
$$\text{,,} \quad \text{,,} \quad gh = 1''{\cdot}714.$$

* For this determination I am indebted to Capt. P. Aldrich, R.N., and the officers of H.M.S. "Fawn."

Digitized by Google

At every reading of the circle the preceding and following divisions were always bisected, so that the corrections for runs at any place could always be determined from the observations there. The several values found were—

Place.	Month.	No. of Observations.	Correction to Mean of 4 Microscope for 1′.
Durban - -	June - -	5	− 0″·05
Zanzibar - -	July - -	14	− 0·12
Aden - -	September -	17	− 0·16
Mozambique -	October - -	14	− 0·18
Durban - -	November -	14	− 0·18

For convenience the zero of level was taken at $30^{d}\cdot0$.

The zenith-point reading was determined by bisecting with the centre wire the horizontal wire of the transit at Durban and Aden, and by pointing on some distant object at other places. The centre wire does not coincide with the mean of the wires, so that a small correction has to be applied to the resulting chronometer-errors at Zanzibar according as the lamp is east or west; the zenith-point reading at Mozambique has been corrected.

Digitized by Google

OBSERVATIONS FOR LATITUDE.

Date.	Star.	Time by Chronometer.	Lamp.	Circle-Reading.	Corr^{n} for Level and Runs.	Refraction.	Concluded Zenith Distance.	Reduction to Meridian.	Tabular App^{t} Declination of Star.	Latitude.
				ZANZIBAR.						
1881.		h m s		° ′ ″	″	″	° ′ ″	′ ″	° ′ ″	° ′ ″
July 29	α Lyræ - - -	16 53 20	L.	314 53 26·4	+10·7	55·4	44 51 36·7	0 36·9	+38 41 18·1	− 6 9 48·8
„	„ - - -	17 5 13	R.	225 11 58·7	+ 9·1	55·6	44 51 52·7	1 27·2		
„	α Gruis - - -	20 21 10	R.	228 40 36·3	+ 9·1	49·2	41 22 59·6	1 1·2	−47 31 43·7	− 6 9 53·3
„	„ - - -	20 31 50	L.	311 24 33·0	+ 8·6	49·2	41 22 35·0	0 52·5		
				MOZAMBIQUE.						
Oct. 23	α Piscis Aust. -	3 37 30	R.	253 46 55·8	+ 7·3	16·2	16 16 10·2	63 26·4	−30 14 48·6	−15 1 47·3
„	„ - -	3 51 30	L.	285 28 12·5	+20·1	15·3	15 25 50·8	12 41·0		
„	α Eridani - -	7 5 12	L.	313 0 23·6	+25·5	51·7	42 58 43·7	10 15·4	−57 50 9·4	−15 1 46·4
„	„ - -	7 15 39	R.	226 52 9·6	− 3·7	52·0	43 11 43·3	23 25·6		

Digitized by Google

OBSERVATIONS FOR TIME

ZANZIBAR.

Date.	Star.	Position of Circle.	Direction of Star.	Chron. Time of Transit over Mean of Wires.	Circle Reading.	Corrections for	
						Runs and Level.	Refraction.
				h m s	° ′ ″	″	″
July 28	α Virginis - -	L.	West -	16 36 32·82	197 58 32·4	+ 7·1	170·8
	„ -	R.	„	16 51 35·88	345 47 59·7	+ 9·7	216·0
	α Scorpii - -	R.	West -	19 4 43·36	334 8 18·1	+ 2·2	114·5
	„ -	L.	„	19 19 23·50	202 41 7·5	+13·9	133·1
	α Andromedæ -	L.	East -	19 39 46·24	216 44 51·5	+ 2·6	74·9
	„ - -	R.	„	19 55 30·92	320 31 54·0	+12·2	67·8
July 29	Mark - - -	R.	- -	} Centre Wire	{ 356 44 23·7	+ 9·1	
	„ - -	L.	- -	}	{ 183 21 13·9	+ 4·8	
	α Virginis - -	L.	West -	16 23 53·80	201 8 16·0	+ 8·8	143·8
	„ - -	R.	„	16 36 10·90	342 2 52·6	+12·0	170·1
	α Aquarii - -	L.	East -	17 33 49·46	226 53 10·0	+ 9·3	52·5
	„ - -	R.	„	17 47 18·02	309 52 40·2	+10·0	46·7
	α Scorpii - -	R.	West -	19 27 56·80	339 20 11·2	+ 7·7	146·3
	„ - -	L.	„	19 40 29·24	197 57 12·7	+ 8·9	170·6
	γ Pegasi - -	R.	East -	19 58 6·62	313 39 58·6	+ 8·7	53·3
	„ - -	L.	„	20 7 28·60	228 27 33·3	+ 9·0	49·7

MOZAMBIQUE.

Oct. 23	θ Scorpii -	R.	West -	3 7 43·76	332 59 34·1	+ 4·5	108·1
	„ - -	L.	„	3 18 45·88	205 5 14·9	+20·0	118·1
	α Tauri - -	L.	East -	5 38 36·60	202 39 5·4	+28·9	132·5
	„ -	R.	„	5 51 44·64	334 35 40·1	− 3·6	116·1
	α Piscis Aust. - -	R.	West -	12 56·46	303 33 47·5	+27·9	36·8
	„ - -	L.	„	25 45·68	233 53 59·3	− 1·3	40·6
	β Orionis - -	L.	East -	39 48·18	215 47 29·9	+15·9	77·0
	„ - -	R.	„	53 25·48	321 1 2·4	+ 6·0	68·4
	Light on St. George's Island - -	{ R.	„	} Centre Wire	{ 359 58 25·9	+ 1·7	
		{ L.	„	}	{ 180 7 7·0	+19·7	

The last column gives the factor by which any change $d\phi$, expressed in seconds of arc, in the assumed

Digitized by Google

WITH THE ALTAZIMUTH.

Latitude — 6° 9′ 51″.

True Observed Zenith Distance.	Apparent Place of Star.		Observed Hour Angle of Star.	Correction for Error in Zenith Pt.	Deduced Correction to Chronometer.	Coeff. of $d\phi$.
	Right Ascension.	Declination.				
° ′ ″	h m s	° ′ ″	h m s	s	h m s	
72 7 7·1	13 18 58·09	−10 32 38·7	+4 51 36·09	+ 0·26	+1 34 1·62	+·011
75 48 49·6	„	„	+5 6 39·80	− ·26	1·75	·011
64 7 19·1	16 22 10·95	−26 10 7·9	+4 16 35·36	− ·28	2·67	·031
67 23 47·4	„	„	+4 31 14·57	+ ·28	2·30	·032
53 19 16·7	0 2 18·04	+28 26 15·1	−2 48 29·03	− ·34	2·43	·062
50 30 18·2	„	„	−2 32 45·33	+ ·36	2·15	·066
69 1 55·5	13 18 58·07	−10 32 38·7	+4 39 1·61	+ 0·26	+1 34 6·14	·011
72 0 8·8	„	„	+4 51 19·18	− ·26	6·09	·011
43 10 29·0	21 59 44·32	+ 0 53 28·6	−2 51 48·60	− ·25	6·01	·006
39 50 41·1	„	„	−2 38 20·81	+ ·25	5·74	·007
69 19 49·4	16 22 10·94	−26 10 7·9	+4 39 52·75	− ·28	6·61	·032
72 8 17·8	„	„	+4 52 24·29	+ ·28	6·27	·032
43 38 4·8	0 7 10·18	+14 31 37·4	−2 34 57·76	+ ·29	6·09	·037
41 36 3·2	„	„	−2 25 34·52	− ·29	6·77	+·039

Latitude — 15° 1′ 47″.

62 58 25·8	17 28 49·70	−42 55 16·5	+4 27 29·12	—	−5 11 24·94	+·060
64 59 24·1	„	„	+4 38 31·12	—	25·06	·060
67 25 39·1	4 29 10·52	+16 16 16·9	−4 2 0·33	—	26·41	·033
64 34 31·7	„	„	−3 48 53·43	—	27·55	·035
33 31 14·5	22 51 8·88	−20 14 49·5	+2 10 21·12	—	26·46	·044
36 9 43·5	„	„	+2 23 9·56	—	27·24	·042
54 16 32·0	5 8 53·26	− 8 20 15·0	−3 40 31·87	—	26·79	·001
50 59 15·9	„	„	−3 26 54·73	—	26·95	+·002

latitude must be multiplied to obtain the corresponding change in the chronometer correction.

Digitized by Google

Zanzibar.

The observations were made on the roof of the Consulate. Dr. (now Sir John) Kirk had built a pillar for the altazimuth on a solid partition wall, which ran right through to the ground, but unfortunately the pillar was too small to carry the foot-screws. (The late) Capt. Brownrigg, H.M.S. "London," most kindly placed the services of his engineers at my disposal, and they cast a brass plate about half an inch thick which was firmly bolted to the pier next morning. The observations on July 28 were made on top of the altazimuth box, which had been provided with three wooden feet for such an emergency: those on the 29th were made on the pier.

Signals were exchanged with the Cape observatory each night, with hand-translation, by Mr. McEwen at Durban. As both clock and chronometer were sidereal several sets of signals were sent and the mean of each set taken.

From the comparisons with the mean time chronometers it appears that Dent lost $2^s{\cdot}6$ on July 28, and $4^s{\cdot}7$ on July 29, and from the signals I deduce the following errors of the standard chronometers on Cape mean time:—

		h	m	s
July 29^d 0^h C.M.T.	Cribb slow	3	41	4·9
	P. & B. „	3	23	39·3

These results have been used as a starting point for the determination of the chronometer errors at Quilimane and at Mozambique (first visit).

Signals.

July 28.

Zanzibar sending.

Zanzibar Chron.			Cape Clock.		
h	m	s	h	m	s
17	36	0 =	17	47	46·9
17	48	0 =	17	59	47·0
18	11	0 =	18	22	46·9

Cape sending.

Zanzibar Chron.			Cape Clock.		
h	m	s	h	m	s
18	5	55·3 =	18	17	40
18	23	55·3 =	18	35	40

whence difference of longitude

h	m	s	h	m	s
= 1	22	48·94	= 1	22	51·16

mean h m s 1 22 50·05

and "loss of time" $\frac{2^s{\cdot}22}{2} = 1^s{\cdot}11$.

July 29.

Zanzibar sending.

Zanzibar Chron.			Cape Clock.		
h	m	s	h	m	s
22	18	0 =	22	29	51·85
22	49	0 =	23	0	52·00

whence difference of longitude

h	m	s
= 1	22	48·41

Cape sending.

Zanzibar Chron.			Cape Clock.		
h	m	s	h	m	s
22	28	50·25 =	22	40	40
22	58	50·15 =	23	10	40

h	m	s
= 1	22	50·54

mean h m s 1 22 49·48

and "loss of time" $= \frac{2^s{\cdot}13}{2} = 1^s{\cdot}07$.

Digitized by Google

Mozambique (second visit).

Oct. 23. The altazimuth was placed in the south-east angle of Sebastian Fort, about 10 or 12 yards to the south of the flagstaff.

Signals could not be got with Durban in the evening, but were exchanged with Mr. McEwen early next morning. He used a Mean-Time Chronometer, which was compared shortly afterwards with the Transit Clock.

The following are some of the comparisons of this chronometer and its error about this time :—

Date.	Durban Transit Clock.	Chronometer.	Corr^{n} to Clock.	Corr^{n} to Chronom.
	h m s	h m s	s	s
Oct. 19	21 10 11	21 10 10·9	−18·0	−17·9
21	21 9 18	21 9 20	−16·5	−18·5
23	21 55 6	21 55 10·3	−15·1	−19·4
25	21 43 44	21 43 50·6	−13·7	−20·3

Hence at the time of the exchange of signals the chronometer was $19^{s}\cdot3$ fast on Durban mean time.

From the comparisons with the standard chronometers Dent was gaining $10^{s}\cdot0$ per day.

Signals.

Mozambique sending.

Mozambique.				Durban.		
h	m	s		h	m	s
14	36	0	=	18	35	5·0
14	39	50	=	18	34	54·5

Durban sending.

Mozambique.				Durban.		
h	m	s		h	m	s
14	23	23·5	=	18	22	30
14	26	34·0	=	18	25	40
14	29	44·5	=	18	28	50

whence difference of longitude—

h	m	s	h	m	s
= 0	38	51·72	= 0	38	52·41

mean - - - h m s 0 38 52·07

and "loss of time" = $\frac{0^{s}\cdot69}{2} = 0^{s}\cdot35$.

Digitized by Google

SECTION VII.

RESULTING LONGITUDES.

The following table represents the final results of my observations. The longitudes used for the Cape Observatory and the Durban Hut respectively are $1^h\ 13^m\ 54^s{\cdot}76$ East, and $2^h\ 4^m\ 6^s{\cdot}9$ East, which are the results of the Cape Longitude Expedition:—

Place.	Position of Station.	Date.	Observed Longitude East of Greenwich.	Adopted Longitude in Arc.
			h m s	° ′ ″
Delagoa Bay	Flagstaff, E.S.A.T.C.	July 13	2 10 22·2	32 35 34
		November 9	2 10 22·3	
Quilimane	Custom House	July 20	2 27 29·9	36 52 28
Mozambique	Flagstaff, Sebastian Fort	July 23	2 42 59·8	
		October 23	2 42 59·0	40 44 45
Zanzibar	British Consulate	July 28	2 36 44·8	39 11 7
		July 29	2 36 44·2	

Throughout the expedition I experienced the greatest kindness and assistance from the members of the E.S.A.T.C., and my thanks are especially due to Messrs. Heraghty, Cassidy, Carlisle, and McEwen, and to Sir John Kirk.

W. H. FINLAY.

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 4.

OCCULTATIONS OF STARS BY THE MOON,

OBSERVED AT THE

ROYAL OBSERVATORY, CAPE OF GOOD HOPE,

IN THE YEARS

1835 TO 1880.

REDUCED AND COMPARED WITH HANSEN'S TABLES OF THE MOON,
UNDER THE SUPERINTENDENCE OF—

DAVID GILL, LL.D., (ABD^{N}. AND EDIN.), F.R.S., &c.

Her Majesty's Astronomer at the Cape of Good Hope.

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY, IN OBEDIENCE TO HER MAJESTY'S COMMAND.

Digitized by Google

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 4.

INTRODUCTION.

The following observations of Occultations of Stars by the Moon, observed at the Royal Observatory, Cape of Good Hope, in the years 1835 to 1880 inclusive, have been collected and reduced for the use of those astronomers who are engaged in researches on the motion of the Moon.

As has already been mentioned in the Introduction to Part 2 of the present volume, I received, soon after my appointment as Her Majesty's Astronomer at the Cape, a letter from Professor Simon Newcomb, stating his desire to obtain the results of a series of observations of occultations of stars by the Moon made at an Observatory in the Southern Hemisphere, for the purpose of determining more accurately the constants of the Lunar Theory on which he was engaged. It gave me much pleasure to state in reply that not only would I undertake to make such a series of observations, but that, on examining the records of the Observatory, I had found a large number of unpublished occultations made under the direction of Sir Thomas Maclear, which I would glady reduce on a uniform system and publish with the least possible delay. Professor Newcomb undertook, for his part, to supply places of the Moon from Hansen's Tables, computed for the instants of occultations observed at the Cape previous to 1862, in which year those Tables were first adopted for the Lunar Ephemerides of the English Nautical Almanac.

As Professor Newcomb desired to receive these results as soon as possible, the computations were commenced without delay, and the results have been supplied to him in MSS. from time to time.

It was further resolved to adopt the then accepted Longitude of the Cape Transit Circle, viz.,—

$$-1^h\ 13^m\ 55^s,$$

for the preliminary reduction of all the observations, as the small corrections of the resulting equations, corresponding with any other value of the longitude which might afterwards be adopted, can be very easily applied. The work was delayed by a variety of causes, and was originally prepared for press in 1884; but during my visit to Europe in that year I received some further results of meridian observations of stars, and had besides so much and such varied work of other kinds on hand, that I decided to further postpone publication and wait a future opportunity of passing the revised work through press.

The form of the Equations of Condition has been adopted without change from the Cambridge (England) Observations, 1861–65. Introduction, pp. xlviii., xlix.

i 12307. 400.—4/87. Wt. 1124.

Digitized by Google

Let T = the mean local time of observation.

l = the assumed longitude, + when West.

α and δ, the Moon's Tabular Right Ascension and Declination.

π and σ, the tabular horizontal equatoreal parallax and semi-diameter of the Moon.

ρ = the radius vector of the place of observation, the Earth's equatoreal radius being taken = unity.

ϕ' = the geocentric latitude.

θ = the sidereal time corresponding to time T.

α' and δ' the R.A. and Declination of the star occulted.

Compute—

$$x = \frac{\sin(\alpha - \alpha')}{\sin 1''} \cos\delta.$$

$$y = \frac{\sin(\delta - \delta')}{\sin 1''} + x \sin\delta' \tan\tfrac{1}{2}(\alpha - \alpha').$$

$$\xi = \frac{\sin\pi}{\sin 1''} \cdot \rho \cos\varphi' \sin(\theta - \alpha').$$

$$\eta = \frac{\sin\pi}{\sin 1''} \rho \{\sin\varphi' \cos\delta' - \cos\phi' \sin\delta' \cos(\theta - \alpha')\}.$$

$$\tan\chi = \frac{y - \eta}{x - \xi}.$$

$$S = \frac{x - \xi}{\cos\chi} = \frac{y - \eta}{\sin\chi}.$$

Also let—

Δl be the correction of the assumed longitude in seconds of time;

ΔT the correction of T in seconds of time;

$\Delta\alpha$, $\Delta\delta$, &c., the corrections of α, δ, &c. in seconds of arc;

$\frac{\sin\pi}{\sin 1''}(1 + p)$ and $\frac{\sin\sigma}{\sin 1''}(1 + s)$, the sines of the true horizontal equatoreal parallax and semi-diameter, each divided by sin 1″.

$\frac{d\alpha}{dt}$ and $\frac{d\delta}{dt}$ the changes of α and δ in a second of time, estimated in seconds of arc.

Calculate the quantities—

$$(\alpha) = \cos\delta\,[\cos\chi + \sin\chi \sin\delta' \sin(\alpha - \alpha')],$$

$$(\delta) = \sin\chi - \cos\chi \sin\delta \sin(\alpha - \alpha'),$$

$$(l) = (\alpha)\frac{d\alpha}{dt} + (\delta)\frac{d\delta}{dt},$$

$$m = \rho \sin\pi \cos\varphi' [\cos\chi \cos(\theta - \alpha') + \sin\chi \sin\delta' \sin(\theta - \alpha')],$$

$$(\alpha') = m - (\alpha),$$

$$(\delta') = \rho \sin\pi \sin\chi [\sin\phi' \sin\delta' + \cos\phi' \cos\delta' \cos(\theta - \alpha')] - \sin\chi,$$

$$(T) = (l) - (1{\cdot}00274)\,15m,$$

$$(\phi') = -\rho \sin\pi [\sin\chi \cos\phi' \cos\delta' + \sin\chi \sin\varphi \sin\delta' \cos(\theta - \alpha'), - \cos\chi \sin\varphi' \sin(\theta - \alpha')],$$

$$(p) = -\xi \cos\chi - \eta \sin\chi,$$

$$(s) = -\frac{\sin\sigma}{\sin 1''},$$

Digitized by Google

Then the final equation of condition is—

$$\frac{\sin \sigma}{\sin 1''} - S = (\alpha)\Delta\alpha + (\delta)\Delta\delta + (\alpha')\Delta\alpha' + (\delta')\Delta\delta' + (T)\Delta T + (l)\Delta l + (\varphi')\Delta\varphi' + (p)p + (s)s.$$

The Right Ascension, Declination, and Parallax of the Moon are computed throughout from Hansen's Tables of the Moon. The adopted semi-diameter, however, is different from Hansen's, viz.,—

$$[9{\cdot}43559] \times \pi.$$

The adopted compression of the Earth is—

$$e = \frac{1}{300},$$

which is that employed in the Greenwich publications for the formation of the equations resulting from the occultations observed at Greenwich.

All modern discussions of the value of e, founded either on arcs of meridian or pendulum experiments, point to a value of e more nearly $= \frac{1}{293}$.

When the reductions were commenced, I had not access to Colonel Clarke's most recent discussion of all the most reliable Geodetic data,* and the value of e used at Greenwich was adopted for sake of uniformity. Professor Newcomb has since shown that the computed tabular distance of a star from the Moon's centre at the time of occultation may differ more than $0''{\cdot}5$ of arc according as Airy's or Clarke's value of e is adopted.

I have seriously considered the desirability of re-computing the equations on this account, but, in the present uncertainty of the *precise* value of e which astronomers may agree to adopt, I preferred to issue the results in their present form, and to publish the final corrections at a subsequent time along with the results of numerous occultations observed at the Cape since 1880.

Valuable additional Geodetic data will soon be available from the operations of the Coast Survey of the United States, the Europäische Gradmessung, and, on a less complete scale, from the new Geodetic Survey of South Africa. It will then be desirable that some agreement should be arrived at amongst astronomers for the adoption of a uniform value of e for the reduction of Lunar Observations.

The astronomical latitude of the Transit Circle which has been adopted for the computations is—

$$-\ 33^\circ\ 56'\ 3''{\cdot}4.$$

The corresponding values of φ' and ρ are—

$$\phi' = -\ 33^\circ\ 45'\ 26''{\cdot}26$$
$$\text{Log}\ \rho = 9{\cdot}9995512.$$

The results of the telegraphic longitude operations, published in Part 2 of this Volume, give for the longitude of the Cape Transit Circle—

$$-\ 1^h\ 13^m\ 54^s{\cdot}76$$

a result which is liable to an uncertainty of, perhaps, $0{\cdot}2^s$ on account of the still unsatis-

---

* The results of the G.T. Survey of India were not available at the time of Airy's computation of the value of e. Colonel Clarke's results are—

From arcs of meridian $e = \frac{1}{293{\cdot}5}$. (Clarke's Geodesy, p. 319.)

From pendulum experiments $= \frac{1}{288{\cdot}7}$ to $\frac{1}{294{\cdot}0}$ (Clarke's Geodesy, pp. 347–348.)

Digitized by Google

factory character of the determination of the longitude of Aden. For the present we must accept, as the most probable value,—

$$\Delta l = + 0^{s}\cdot 24$$

applicable to observations after 1855, when the Transit Circle was brought into use.

Before the Transit Circle was erected the time determinations were made with the Dollond 10-ft. Transit instrument, which is situated 52 feet W. of the Transit Circle; thus, for all observations made previous to 1856·0, the most probable correction to the adopted longitude is—

$$\Delta l = + 0^{s}\cdot 28.$$

It is impossible to define precisely the position of the observing instruments previous to 1847. A 5-ft. telescope by Jones, and a 45-in. telescope by Dollond, were mounted on portable stands, placed generally in the open air, in shelter from the wind at the time, near the main building.

In 1847 the Dollond Telescope was mounted on an equatorial stand under a small dome 57 feet East and 198 feet North of the present Transit Circle.

In 1849 the Merz 8½-ft. Equatorial was mounted in its present observatory 144 feet West and 198 feet North of the present Transit Circle.

The various observers are denoted as follows:—

T.M.	Sir Thomas Maclear.
W.M.	Mr. W. Mann.
C.P.S.	„ C. Piazzi Smyth.
G.F.C.	„ G. F. Childe.
G.M.	„ G. Maclear.
J.S.	„ J. Sinfield.
C.S.	„ C. M. Stevens.
D.G.	„ D. Gill.
W.H.F.	„ W. H. Finlay.
R.P.	„ R. T. Pett.

Mr. Mann's notes on the occultation of λ Virginis, 1865, June 7 (No. 378), are of exceptional interest.

There are several instances of mistakes in the original observations which might have been corrected with tolerable certainty (for example, the impossible value of $\frac{\sin \sigma}{\sin 1''} - S = 30''\cdot 06$ in No. 415 becomes $+ 4''\cdot 32$ if we suppose that the observed time should be diminished one minute), but it seems better to leave these conjectural alterations to be made by the astronomer who may undertake the comparison with a new Lunar Theory. In every case the original notes of the observer have been reproduced.

From an examination of the following observations, as well as from the results of considerable experience, I have come to the conclusion that for refined purposes very little confidence can be placed on observations of Disappearances at the bright limb for stars below third magnitude, and of Reappearances at the bright limb of stars below second magnitude.

The apparent places of the occulted stars have been computed, as far as possible, from *Newcomb's Catalogue of* 1,098 *Standard Zodiacal Stars*. For stars not contained in that work the adopted mean places are given in a separate catalogue, together with the authorities on which the adopted places depend.

DAVID GILL.

Royal Observatory, Cape of Good Hope,
31st December 1886.

Digitized by Google

OCCULTATIONS OF STARS

OBSERVED AT THE

ROYAL OBSERVATORY, CAPE OF GOOD HOPE.

1835—1880.

Digitized by Google

OCCULTATIONS OF STARS OBSERVED AT THE

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1834.					h m s	h m s
1	March 20	Weisse VIII. 85	D D	Jones	T. M.	9 10 56·78	8 5 33·27
2	March 20	"	D D	Dollond	M.	9 10 57·08	8 5 33·57
3	July 14	Lal. 26414	D D	Dollond	T. M.	15 38 50·92	6 56 18·31
4	July 14	"	"	Jones	M.	15 38 50·86	6 56 18·25
5	Aug. 30	κ Geminorum	R D	Dollond	T. M.	4 13 11·00	16 23 47·05
6	Dec. 8	W.B. XXIII. 1016	D D	Dollond	T. M.	1 22 16·40	7 0 9·58
7	Dec. 8	W.B. XXIII. 1029	D D	Dollond	T. M.	1 49 58·42	7 27 47·06
	1835.						
8	Jan. 18	ξ Virginis	D B	Dollond	T. M.	9 9 4·59	12 4 28·89
9	Jan. 18	ξ Virginis	R D	Dollond	T. M.	9 56 42·87	12 51 59·37
10	June 12	h^2 Sagittarii	D B	Dollond	T. M.	17 50 19·30	11 14 11·38
11	June 14	ϵ Capricorni	D B	Dollond	T. M.	18 18 46·04	11 34 41·63
12	Aug. 6	h^1 Sagittarii	D B	Dollond	T. M.	15 50 36·16	5 38 32·70
13	Aug. 6	h^2 Sagittarii	D B	Dollond	T. M.	15 58 3·37	5 45 58·69
14	Aug. 6	h^2 Sagittarii	R D	Dollond	T. M.	17 12 9·47	6 59 52·65
15	Aug. 8	κ Capricorni	D B	Dollond	T. M.	20 0 28·94	9 39 52·72
16	Oct. 29	κ Capricorni	D D	Dollond	T. M.	21 25 53·65	5 42 38·98
	1836.						
17	Feb. 8	Lal. 26280	R D	Dollond	T. M.	9 19 49·26	10 53 34·68
18	Feb. 8	Lal. 26307	R D	Dollond	T. M.	9 47 26·75	11 21 7·65
19	June 28	φ Sagittarii	R B	Dollond	T. M.	20 44 34·59	13 2 4·56
20	Aug. 22	φ Sagittarii	D D	Jones	T. M.	17 50 49·63	6 32 32·96
21	Aug. 22	φ Sagittarii	R B	Jones	T. M.	19 14 53·99	7 56 23·55
22	Sept. 16	O. Arg. 15613	D D	Dollond	T. M.	21 37 21·71	8 40 10·24
23	Sept. 16	ρ Ophiuchi	D D	Dollond	T. M.	21 42 39·09	8 45 26·75
24	Sept. 16	O. Arg. 15621	D D	Dollond	T. M.	21 44 45·43	8 47 32·75
25	Sept. 21	ϵ Capricorni	D D	Dollond	T. M.	21 29 41·42	8 12 51·64
26	Sept. 21	ϵ Capricorni	R B	Dollond	T. M.	22 41 58·92	9 24 57·30
27	Oct. 21	27 Piscium	D D	Jones	C. P. S.	23 49 33·62	8 34 23·70
28	Oct. 21	29 Piscium	D D	Jones	C. P. S.	2 3 28·89	10 47 57·03
29	Oct. 21	29 Piscium	R B	Dollond	T. M.	3 16 11·90	12 0 28·12
30	Dec. 12	O. Arg. 21626	D D	Jones	C. P. S.	2 57 9·27	8 17 1·24
	1837.						
31	May 9	Lal. 14185	D D	Jones	C. P. S.	9 45 24·35	5 22 14·78
32	June 16	δ Scorpii	D D	Dollond	T. M.	13 22 50·57	6 29 40·74
33	Aug. 11	O. Arg. 16481	D D	Dollond	T. M.	18 51 41·37	8 17 26·59
34	Nov. 12	23 Tauri	D B	Jones	C. P. S.	5 22 39·64	12 41 1·99
	1838.						
35	Aug. 12	19 Tauri	R D	Jones	C. P. S.	1 26 13·45	14 47 54·95
36	Oct. 5	ϵ Arietis	D B	Jones	C. P. S.	2 58 27·23	12 47 34·55
37	Nov. 29	ϵ Arietis	D D	Jones	C. P. S.	3 30 22·14	9 43 9·19

9, 12, 13, 14, 15, 25, 35. Good observations.

22, 23. Both disappeared gradually, and were both within the apparent disc of the Moon. Same phenomenon observed for 27 by C.P.S.

Digitized by Google

ROYAL OBSERVATORY, CAPE OF GOOD HOPE. 1835–80.

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
8 3 45·96	+22 44 4·9	58 58·7	16 4·8	8 3 51·15	+23 37 50·5
14 19 43·28	− 9 40 11·3	59 3·7	16 6·2	14 19 41·34	− 9 15 23·6
7 32 52·14	+24 5 12·7	58 10·0	15 51·5	7 34 25·24	+24 47 20·6
23 48 59·83	− 6 54 59·9	54 32·8	14 52·3	23 48 39·71	− 6 22 46·8
23 49 50·43	− 6 49 21·0	54 32·4	14 52·2	23 49 18·26	− 6 22 50·2
11 33 46·68	+ 8 26 19·7	58 52·3	16 3·0	11 36 46·50	+ 9 10 29·0
11 35 29·31	+ 8 15 8·2	58 52·7	16 3·0	11 36 46·50	+ 9 10 29·0
19 24 6·95	−25 31 58·7	59 35·5	16 14·7	19 26 41·36	−25 14 24·3
21 24 17·07	−20 25 41·7	57 46·6	15 45·2	21 27 51·19	−20 11 58·4
19 22 20·41	−25 33 49·4	59 2·6	16 5·7	19 26 2·69	−25 4 23·2
19 22 39·79	−25 33 29·6	59 2·4	16 5·7	19 26 42·12	−25 14 24·7
19 25 52·15	−25 30 2·7	59 1·3	16 5·4	19 26 42·12	−25 14 24·7
21 31 3·04	−19 47 48·3	57 56·8	15 48·0	21 33 28·58	−19 36 41·7
21 32 36·71	−20 2 7·3	57 12·4	15 35·7	21 33 28·21	−19 36 45·8
14 12 30·39	−11 29 30·0	58 33·7	15 58·0	14 14 36·58	−10 57 41·0
14 13 29·52	−11 36 0·4	58 34·2	15 58·1	14 15 52·24	−10 55 18·6
18 38 4·89	−27 4 46·2	61 22·6	16 43·6	18 35 26·98	−27 9 8·4
18 33 29·59	−27 17 17·9	60 5·6	16 22·9	18 35 27·08	−27 9 10·6
18 37 19·11	−27 16 49·1	60 6·6	16 23·3	18 35 27·08	−27 9 10·6
16 17 58·01	−23 35 7·2	58 51·6	16 2·9	16 15 36·24	−23 4 38·7
16 18 10·99	−23 35 53·5	58 51·8	16 2·9	16 15 46·92	−23 3 54·3
16 18 16·16	−23 36 11·9	58 51·7	16 2·9	16 15 47·24	−23 1 23·0
21 26 48·69	−20 26 41·9	59 21·7	16 11·1	21 27 56·18	−20 11 40·8
21 29 41·62	−20 12 47·7	59 20·9	16 10·9	21 27 56·18	−20 11 40·8
23 49 57·21	− 5 10 42·4	57 46·8	15 45·1	23 50 19·47	− 4 27 39·6
23 54 25·97	− 4 36 14·5	57 44·3	15 44·5	23 53 28·01	− 3 56 7·7
23 56 51·58	− 4 17 30·4	57 42·9	15 44·1	23 53 28·01	− 3 56 7·7
21 40 4·06	−19 20 34·4	59 44·7	16 17·3	21 37 24·41	−18 40 11·7
7 11 26·71	+27 32 24·4	54 28·6	14 51·2	7 10 10·96	+28 25 3·3
15 47 36·41	−22 33 3·8	59 9·2	16 7·6	15 50 44·64	−22 9 18·6
17 4 35·73	−26 54 18·0	59 3·5	16 6·1	17 4 8·11	−26 47 6·0
3 37 20·69	+22 30 32·1	57 36·6	15 42·3	3 36 43·66	+23 26 24·7
3 34 18·70	+23 25 19·1	57 58·1	15 48·2	3 35 36·43	+23 57 33·6
2 50 45·54	+20 6 45·4	60 16·1	16 25·9	2 50 1·15	+20 41 37·2
2 49 34·21	+19 59 8·0	60 5·4	16 23·0	2 50 1·83	+20 41 40·9

24. Disappeared suddenly, and *not* within the disc.
26. May be erroneous to the amount of two seconds.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1839.					h m s	h m s
38	May 6	δ Capricorni	R D	Dollond	T. M.	17 26 18·44	13 15 34·69
39	May 24	α Virginis	D B	Dollond	T. M.	9 22 13·43	4 2 2·61
40	May 24	α Virginis	R B	Dollond	T. M.	9 38 16·63	4 18 3·19
41	June 3	σ Aquarii	D B	Dollond	T. M.	22 44 46·12	16 43 4·68
42	June 24	α Scorpii	D D	Dollond	T. M.	14 12 26·27	6 49 34·61
43	Aug. 17	A^1 Scorpii	D D	Dollond	T. M.	19 55 2·24	8 58 55·24
44	Aug. 17	A^2 Scorpii	D D	Dollond	T. M.	20 27 21·44	9 31 9·14
	1840.						
45	Feb. 15	γ Cancri	D	Dollond	T. M.	9 26 58·33	10 33 2·60
46	,,	,,	,,	Jones	C. P. S.	9 26 59·03	10 33 3·30
47	Feb. 15	γ Cancri	R	Dollond	T. M.	10 7 3·21	11 13 0·92
48	Feb. 26	3 Sagittarii	D B	Dollond	T. M.	10 50 50·55	11 13 26·10
49*	March 23	α Scorpii	D B	Jones	W. M.	9 33 27·24	8 14 1·87
50	March 23	α Scorpii	R D	Jones	W. M.	10 26 46·69	9 7 12·59
51	April 13	τ Leonis	R B	Dollond	T. M.	10 28 58·62	7 46 50·07
52	May 9	ρ Leonis	D D	Dollond	T. M.	13 41 57·35	9 17 3·53
53	,,	,,	,,	Jones	C. P. S.	13 41 56·35	9 17 2·53
54	May 18	3 Sagittarii	D B	Dollond	T. M.	14 16 18·41	9 15 55·78
55	May 18	3 Sagittarii	R D	Dollond	T. M.	15 40 48·50	10 40 12·03
56	May 19	φ Sagittarii	D B	Dollond	T. M.	16 57 32·94	11 52 47·97
57	May 19	φ Sagittarii	R D	Dollond	T. M.	18 34 42·56	13 29 41·68
58	May 20	h^2 Sagittarii	D B	Dollond	T. M.	15 45 42·71	10 37 13·60
59	May 20	h^2 Sagittarii	R D	Dollond	T. M.	17 10 29·02	12 1 46·02
60	May 22	ι Capricorni	D B	Dollond	T. M.	19 16 11·22	13 59 15·80
61	May 22	ι Capricorni	R D	Dollond	T. M.	20 37 43·98	15 20 35·20
62	June 12	A^1 Scorpii	D D	Dollond	T. M.	20 57 52·49	14 18 6·27
63	,,	,,	,,	Jones	W. M.	20 57 52·59	14 18 6·37
	1841.						
64	June 30	α Scorpii	D D	Jones	W. M.	18 41 0·56	10 51 47·20
65	,,	,,	,,	Dollond	C. P. S.	18 41 0·91	10 51 47·55
	1843.						
66	Sept. 11	η Piscium	D B	Dollond	W. M.	1 19 43·98	12 44 17·91
	1844.						
67	Jan. 8	π Leonis	D B	Dollond	W. M.	6 7 39·12	9 43 32·66
68	Jan. 8	π Leonis	R D	Dollond	W. M.	7 22 13·03	10 57 54·35
69	Jan. 31	2 Geminorum	D D	Dollond	T. M.	7 35 48·31	9 41 1·45
70	May 31	O. Arg. 15890	D	Dollond	W. M.	15 53 42·41	10 1 49·09
71	May 31	O. Arg. 15930	D	Dollond	W. M.	17 11 57·77	11 19 51·63
72	June 25	B.A.C. 4700	D D	Dollond	W. M.	18 0 51·46	10 30 19·52
73	June 25	B.A.C. 4700	R B	Dollond	W. M.	18 28 34·46	10 57 57·98

38, 39, 40, 42, 43, 44, 45, 51, 52, 57, 60, 61, 62, 64, 68, 70, 73. Good observations.

39. On the Moon's bright limb. The star seemed projected on the limb two or three seconds.

41. May be erroneous 2^s, for the small star on the bright limb was partially lost as to decided distinction when in contact, and the time registered is when the apparent projection on the limb as a lunar mountain vanished.

* One minute has been added to the recorded time of disappearance.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
21 36 15·95	−17 13 50·4	58 0·4	15 48·9	21 38 10·05	−16 51 14·3
13 14 33·31	−10 31 10·6	54 2·8	14 44·1	13 16 45·35	−10 19 24·5
13 15 2·01	−10 34 42·6	54 2·8	14 44·1	13 16 45·35	−10 19 24·5
22 21 27·09	−11 57 2·0	58 5·0	15 50·2	22 22 9·09	−11 29 51·8
16 16 45·11	−26 19 6·5	54 51·4	14 57·3	16 19 35·98	−26 4 20·6
15 45 56·95	−25 3 46·2	54 29·5	14 51·4	15 44 0·09	−24 50 43·0
15 47 5·69	−25 7 41·7	54 29·9	14 51·5	15 45 2·93	−24 45 54·3
8 34 53·29	+21 30 23·5	58 29·2	15 56·7	8 34 3·48	+22 2 19·2
8 34 53·32	+21 30 23·4	58 29·2	15 56·7	8 34 3·48	+22 2 19·2
8 36 27·26	+21 22 50·9	58 28·5	15 56·5	8 34 3·48	+22 2 19·2
17 33 4·54	−28 21 48·9	54 33·7	14 52·6	17 37 30·26	−27 45 52·2
16 15 12·79	−26 34 45·8	54 9·4	14 45·9	16 19 38·32	−26 4 24·3
16 17 10·39	−26 39 24·3	54 9·5	14 45·9	16 19 38·32	−26 4 24·3
11 19 48·27	+ 2 59 17·1	55 57·5	15 15·4	11 19 44·82	+ 3 43 59·0
10 26 4·39	+ 9 41 44·8	56 45·0	15 28·3	10 24 24·83	+10 7 32·6
10 26 4·36	+ 9 41 45·0	56 45·0	15 28·3	10 24 24·83	+10 7 32·6
17 33 49·40	−27 57 50·7	54 1·2	14 43·6	17 37 32·87	−27 45 53·5
17 36 57·69	−27 58 14·6	54 1·6	14 43·9	17 37 32·87	−27 45 53·5
18 33 12·89	−27 19 55·8	54 12·8	14 46·8	18 35 42·66	−27 8 56·8
18 36 47·84	−27 14 33·8	54 13·8	14 47·1	18 35 42·66	−27 8 56·8
19 23 10·93	−25 33 10·9	54 29·6	14 51·4	19 27 0·82	−25 13 49·3
19 26 14·25	−25 24 24·9	54 30·8	14 51·7	19 27 0·82	−25 13 49·3
21 10 43·69	−17 49 41·5	55 33·5	15 8·8	21 13 22·04	−17 30 37·6
21 13 27·71	−17 33 51·8	55 35·7	15 9·4	21 13 22·04	−17 30 37·6
15 46 29·62	−25 4 30·8	53 59·0	14 43·1	15 44 4·50	−24 50 54·3
15 46 29·62	−25 4 30·8	53 59·0	14 43·1	15 44 4·50	−24 50 54·3
16 20 41·87	−26 8 46·0	54 42·9	14 54·2	16 19 44·07	−26 4 36·9
16 20 41·88	−26 8 46·0	54 42·9	14 54·2	16 19 44·07	−26 4 36·9
1 23 10·98	−13 39 37·9	54 1·5	14 43·8	1 23 9·88	+14 32 28·5
9 48 20·78	+ 8 17 42·9	57 46·4	15 45·0	9 52 0·13	+ 8 47 12·1
9 50 57·90	+ 8 2 2·1	57 47·8	15 45·4	9 52 0·13	+ 8 47 12·1
5 57 43·04	+22 47 55·9	55 40·1	15 10·7	5 57 20·81	+23 38 46·4
16 33 16·28	−22 19 23·9	61 13·6	16 41·4	16 35 2·02	−22 13 31·8
16 36 49·65	−22 21 59·2	61 13·0	16 41·2	16 37 12·31	−22 20 16·9
14 4 39·84	−16 12 6·4	59 53·6	16 19·8	14 2 23·14	−15 34 0·0
14 5 46·69	−16 16 39·4	59 54·2	16 19·9	14 2 23·14	−15 34 0·0

46. The star may have emerged 1ˢ or 2ˢ when seen on the limb as a bright point.
48. Uncertain; star faint and low; vapour floating about. When the star came into contact it was immediately lost.
49. Moon very low and enveloped in haze; the limb ragged and undulating.
54. The star could not be seen after it came into contact with the bright limb. Wind and bad images.
70, 71. Moon eclipsed at the time.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1846.					h m s	h m s
74	July 5	O. Arg. 15265	D D	Dollond	T. M.	17 26 25·53	9 18 34·82
	1847.						
75	April 25	*d* Leonis	D D	Dollond	G. F. C.	11 17 33·34	7 50 50·13
76	June 17	*o* Leonis	D D	Dollond	G. F. C.	13 58 23·00	7 2 50·24
77	Oct. 18	*ν* Aquarii	D D	Dollond	G. F. C.	23 52 32·92	8 51 46·12
	1848.						
78	March 28	c^2 Sagittarii	D	Dollond	T. M.	17 52 47·58	16 12 6·59
79	April 15	B.A.C. 4019	D D	Dollond	T. M.	11 50 40·88	9 0 12·91
80	April 15	B.A.C. 4019	R B	Dollond	T. M.	12 58 19·86	10 7 40·81
81	May 8	Lal. 16224	D D	Dollond	T. M.	9 31 56·66	5 11 25·54
82	May 17	γ^1 Libræ	D D	Dollond	T. M.	13 59 27·18	9 2 49·06
83	,,	,,	,,	Jones	W. M.	13 59 27·06	9 2 48·94
84	May 17	γ^1 Libræ	R B	Dollond	T. M.	15 31 57·28	10 35 4·00
85	June 8	*τ* Leonis	D D	Dollond	T. M.	15 47 41·53	9 24 15·64
86	,,	,,	,,	Jones	W. M.	15 47 41·64	9 24 15·75
87	Nov. 8	*e* Piscium	D D	Dollond	W. M.	0 54 21·00	8 27 51·61
88	Nov. 11	δ^1 Tauri	D B	Dollond	W. M.	7 33 8·34	14 53 45·89
89	,,	,,	,,	Jones	G. F. C.	7 33 7·30	14 53 44·85
	1849.						
90	Feb. 13	ξ^2 Libræ	D B	Jones	G. F. C.	10 16 9·77	11 26 45·07
91	Feb. 13	ξ^2 Libræ	R D	Dollond	T. M.	11 28 35·18	12 38 58·62
92	,,	,,	,,	Jones	G. F. C.	11 28 36·88	12 39 0·33
93	April 6	*γ* Virginis (N)	D D	Dollond	T. M.	10 53 23·42	8 39 25·49
94	,,	,,	,,	Jones	G. F. C.	10 53 20·21	8 39 22·29
95	April 6	*γ* Virginis (S)	D D	Dollond	T. M.	10 53 24·72	8 39 26·79
96	,,	,,	,,	Jones	G. F. C.	10 53 23·92	8 39 25·99
97	April 6	*γ* Virginis (N)	R B	Dollond	T. M.	12 20 55·50	10 6 43·23
98	April 6	*γ* Virginis (S)	R B	Dollond	T. M.	12 20 58·50	10 6 46·22
99	,,	,,	,,	Jones	G. F. C.	12 20 53·10	10 6 40·84
100	July 13	ξ^1 Ceti	D B	Jones	W. M.	21 35 27·00	12 54 24·76
101	July 13	ξ^1 Ceti	R D	Dollond	T. M.	22 5 3·19	13 23 56·10
102	,,	,,	,,	Jones	W. M.	22 5 3·38	13 23 56·29
103	Sept. 25	ζ^1 Sagittarii	D D	Merz	T. M.	21 55 51·97	8 23 49·20
104	,,	,,	,,	Dollond	W. M.	21 55 52·00	8 23 49·23
105	,,	,,	,,	Jones	G. F. C.	21 55 51·90	8 23 49·13
106	Sept. 25	ζ^1 Sagittarii	R B	Merz	T. M.	22 56 31·06	9 24 18·36
107	Oct. 3	ξ^1 Ceti	R D	Merz	T. M.	22 1 6·59	7 57 35·72
108	,,	,,	,,	Dollond	W. M.	22 1 6·41	7 57 35·54
109	Nov. 21	Lal. 41168	D D	Merz	T. M.	0 10 12·60	6 53 41·10

74. Uncertain 1^s or 2^s.
75. 81, 82. Good observations.
76. The star well defined, and the effect of earth-shine unusually conspicuous; there seemed to be projection for a very minute portion of time.
78. Uncertain to $0^s·5$; high south wind.
80. Uncertain 2^s or 3^s.
83. Perhaps doubtful to $0^s·5$.
87. Not very accurate; the noise of the wind rendered the clock beat nearly inaudible.
88. Not very exact; moon's limb badly defined.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
15 59 38·23	−18 15 9·5	58 40·9	15 59·9	15 59 18·73	−17 49 16·8
10 52 1·73	+ 3 52 11·5	54 5·5	14 44·8	10 52 41·39	+ 4 26 0·3
9 34 52·37	+10 6 43·4	54 55·8	14 58·5	9 32 59·72	+10 34 55·8
21 2 29·27	−11 58 53·2	58 47·4	16 1·7	21 1 18·35	−11 58 54·0
19 31 20·84	−16 48 2·1	56 52·2	15 30·3	19 33 49·69	−16 28 23·2
11 45 51·85	+ 1 6 33·9	54 21·0	14 49·1	11 46 5·43	+ 1 23 39·5
11 47 59·83	+ 0 56 15·1	54 20·2	14 48·9	11 46 5·43	+ 1 23 39·5
8 10 5·03	+15 36 58·3	57 24·1	15 39·0	8 9 39·88	+16 8 33·1
15 25 1·51	−14 28 29·2	54 9·6	14 46·0	15 27 4·44	−14 16 43·5
15 25 1·51	−14 28 29·1	54 9·6	14 46·0	15 27 4·44	−14 16 43·5
15 28 7·30	−14 37 30·7	54 10·0	14 46·2	15 27 4·44	−14 16 43·5
11 22 28·91	+ 3 23 0·7	55 4·9	15 1·0	11 20 8·41	+ 3 41 24·0
11 22 28·91	+ 3 23 0·7	55 4·9	15 1·0	11 20 8·41	+ 3 41 24·0
0 59 44·97	+ 4 1 11·3	60 34·6	16 30·9	1 0 36·10	+ + 50 57·8
4 15 57·61	+16 19 20·8	61 21·0	16 43·6	4 14 14·56	+17 10 54·6
14 44 45·07	−11 10 0·6	54 30·6	14 51·9	14 48 35·39	−10 47 45·9
14 47 6·91	−11 19 11·5	54 29·6	14 51·4	14 48 35·39	−10 47 45·9
14 47 6·97	−11 19 11·7	54 29·6	14 51·4	14 48 35·39	−10 47 45·9
12 31 54·18	− 0 58 58·7	55 42·6	15 11·3	12 34 2·15	− 0 37 17·7
12 31 54·07	− 0 58 58·2	55 42·6	15 11·3	12 34 2·15	− 0 37 17·7
12 31 54·22	− 0 58 58·9	55 42·6	15 11·3	12 34 2·32	− 0 37 22·6
12 31 54·20	− 0 58 58·8	55 42·6	15 11·3	12 34 2·32	− 0 37 22·6
12 34 48·18	− 1 13 35·0	55 40·9	15 10·8	12 34 2·15	− 0 37 17·7
12 34 48·28	− 1 13 35·5	55 40·9	15 10·8	12 34 2·32	− 0 37 22·6
12 34 48·10	− 1 13 34·6	55 40·9	15 10·8	12 34 2·32	− 0 37 22·6
2 1 8·88	+ 7 43 17·6	58 42·7	16 0·4	2 5 1·21	+ 8 8 11·4
2 2 14·73	+ 7 48 23·2	58 43·6	16 0·6	2 5 1·21	+ 8 8 11·4
2 2 14·73	+ 7 48 23·2	58 43·6	16 0·6	″	″
19 14 23·51	−18 37 13·7	54 27·9	14 50·9	19 12 57·02	−18 7 22·0
19 14 23·51	−18 37 13·7	54 27·9	14 50·9	″	″
19 14 23·51	−18 37 13·7	54 27·9	14 50·9	″	″
19 16 30·31	−18 35 16·8	54 28·6	14 51·1	″	″
2 2 41·54	+ 7 46 36·0	59 1·6	16 5·5	2 5 3·22	+ 8 8 21·9
2 2 41·54	+ 7 46 36·0	59 1·6	16 5·5	″	″
21 7 43·69	−15 17 28·2	54 40·0	14 54·3	21 6 12·61	−14 45 48·9

97, 98. Uncertain; the noise and rattling of the door, owing to the strong wind, drowned the sound of the clock beat, so that for several seconds before reappearance the count was carried on by estimate.

99. No appreciable portion of time could be distinguished with this telescope between the reappearance of the first and second star.

100. Very doubtful; a sort of estimate

101. Excellent.

103, 106. Good observations; reappearance instantaneous.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1849.					h m s	h m s
110	Nov. 23	λ Aquarii	D D	Dollond	W. M.	0 36 17·15	7 11 49·56
111	,,	,,	,,	Jones	G. F. C.	0 36 16·53	7 11 48·94
112	Nov. 23	λ Aquarii	R B	Dollond	W. M.	1 53 6·40	8 28 26·22
113	Nov. 26	μ Piscium	D D	Merz	T. M.	4 39 29·41	11 2 34·24
114	,,	,,	,,	Dollond	W. M.	4 39 29·09	11 2 33·92
115	,,	,,	,,	Jones	G. F. C.	4 39 28·98	11 2 33·81
116	Dec. 1	ν Geminorum	D B	Dollond	W. M.	2 26 2·08	8 29 49·23
117	Dec. 1	ν Geminorum	R D	Merz	T. M.	3 8 33·18	9 12 13·36
118	,,	,,	,,	Dollond	W. M.	3 8 33·33	9 12 13·51
119	,,	,,	,,	Jones	G. F. C.	3 8 31·92	9 12 12·10
	1850.						
120	Jan. 17	φ Aquarii	D D	Merz	T. M.	4 56 26·31	7 55 0·99
121	,,	,,	,,	Dollond	W. M.	4 56 25·94	7 55 0·62
122	,,	,,	,,	Jones	G. F. C.	4 56 26·56	7 55 1·24
123	Jan. 23	δ^2 Tauri	D D	Jones	G. F. C.	5 38 46·89	8 13 39·18
124	Jan. 25	ν Geminorum	D D	Dollond	W. M.	5 10 59·54	7 38 4·56
125	,,	,,	,,	Jones	G. F. C.	5 10 59·92	7 38 4·94
126	Jan. 25	ν Geminorum	R B	Merz	T. M.	6 27 37·99	8 54 30·45
127	,,	,,	,,	Jones	G. F. C.	6 27 38·34	8 54 30·80
128	Feb. 21	χ^3 Orionis	D D	Merz	T. M.	6 45 0·98	7 25 41·07
129	,,	,,	,,	Dollond	W. M.	6 45 0·67	7 25 40·76
130	,,	,,	,,	Jones	G. F. C.	6 45 1·33	7 25 41·42
131	Feb. 21	χ^3 Orionis	R B	Dollond	W. M.	7 31 50·08	8 12 22·50
132	Feb. 21	χ^4 Orionis	D D	Merz	T. M.	7 0 47·69	7 41 25·20
133	,,	,,	,,	Dollond	W. M.	7 0 47·74	7 41 25·25
134	Feb. 21	χ^4 Orionis	R B	Dollond	W. M.	7 50 28·54	8 30 57·91
135	April 17	Lal. 12358	D D	Merz	T. M.	8 10 45·72	5 14 56·91
136	,,	,,	,,	Dollond	W. M	8 10 45·64	5 14 56·83
137	April 17	ν Geminorum	D D	Merz	T. M.	8 15 30·02	5 19 40·43
138	,,	,,	,,	Dollond	W. M.	8 15 29·83	5 19 40·24
139	,,	,,	,,	Jones	G. F. C.	8 15 29·69	5 19 40·10
140	April 17	ν Geminorum	R B	Merz	T. M.	9 21 29·93	6 25 29·53
141	,,	,,	,,	Dollond	W. M.	9 21 24·04	6 25 23·66
142	June 13	Lal. 17615	D D	Merz	T. M.	12 49 39·06	6 8 57·73
143	June 13	Lal. 17633	D D	Merz	T. M.	12 50 43·76	6 10 2·25
144	July 30	ν Piscium	R D	Merz	T. M.	22 5 9·65	12 18 9·51
145	,,	,,	,,	Dollond	W. M.	22 5 9·67	12 18 9·53
146	Aug. 31	χ^4 Orionis	D B	Dollond	W. M.	2 56 27·67	15 2 50·74
147	Sept. 1	ζ Geminorum	R D	Dollond	W. M.	3 16 36·29	15 19 0·15
148	Sept. 30	δ Cancri	R D	Dollond	W. M.	4 7 7·71	14 15 22·01
149	Nov. 17	ξ^1 Ceti	D D	Dollond	W. M.	0 11 6·94	7 11 16·34
150	Nov. 17	ξ^1 Ceti	R B	Dollond	W. M.	0 39 53·01	7 39 57·70
	1851.						
151	March 9	δ^3 Tauri	D D	Merz	T. M.	8 49 35·01	8 27 57·57
152	,,	,,	,,	Dollond	W. M.	8 49 34·97	8 27 57·53
153	,,	,,	,,	Jones	G. F. C.	8 49 35·19	8 27 57·75
154	March 26	υ Capricorni	D B	Dollond	G. F. C.	17 47 58·13	16 18 2·08
155	April 18	B.A.C. 5579	D B	Merz	T. M.	15 58 30·47	12 58 26·50
156	April 18	B.A.C. 5579	R D	Merz	T. M.	16 42 37·03	13 42 25·83

110, 112, 113, 120, 121. 124, 128, 132, 136, 138, 144, 145, 147. 148, 149, 151. Good observations.

116. Thin vapour over moon; time registered is that of the close contact of the star with the limb, when they could not be relatively distinguished.

129. Uncertain, owing to the star being thrown suddenly to the border of the field when moving the instrument in R.A. at the moment of the occurrence of the phenomenon.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
22 45 29·38	− 8 57 50·7	55 54·7	15 14·6	22 44 46·33	− 8 22 37·5
22 45 29·36	− 8 57 50·8	55 54·7	15 14·6	,,	,,
22 48 4·65	− 8 45 55·4	55 57·2	15 15·3	,,	,,
1 24 21·58	+ 4 31 57·2	58 47·9	16 1·8	1 22 19·81	+ 5 22 4·1
1 24 21·57	+ 4 31 57·3	58 47·9	16 1·8	,,	,,
1 24 21·57	+ 4 31 57·3	58 47·9	16 1·8	,,	,,
6 16 23·08	+19 22 33·0	61 5·8	16 39·5	6 20 3·63	+20 17 58·9
6 18 16·33	+19 23 9·3	61 5·8	16 39·4	,,	,,
6 18 16·34	+19 23 9·3	61 5·8	16 39·4	,,	,,
6 18 16·28	+19 23 9·3	61 5·8	16 39·4	,,	,,
23 8 59·73	− 7 33 41·5	55 15·6	15 4·0	23 6 31·85	− 6 51 30·7
23 8 59·72	− 7 33 41·5	55 15·6	15 4·0	,,	,,
23 8 59·74	− 7 33 41·5	55 15·6	15 4·0	,,	,,
4 16 18·86	+16 4 37·1	59 42·4	16 16·7	4 15 27·64	+17 5 23·1
6 17 55·52	+19 22 43·8	60 57·2	16 37·1	6 20 4·19	+20 17 58·0
6 17 55·54	+19 22 43·8	60 57·2	16 37·1	,,	,,
6 21 18·59	+19 23 58·3	60 58·5	16 37·4	,,	,,
6 21 18·60	+19 23 58·3	60 58·5	16 37·4	,,	,,
5 54 39·89	+19 6 44·5	59 43·8	16 17·0	5 54 35·20	+19 41 7·8
5 54 39·88	+19 6 44·5	59 43·8	16 17·0	,,	,,
5 54 39·90	+19 6 44·5	59 43·8	16 17·0	,,	,,
5 56 38·27	+19 8 26·7	59 44·	16 17·3	,,	,,
5 55 19·77	+19 7 19·5	59 44·1	16 17·1	5 55 1·20	+20 8 3·9
5 55 19·77	+19 7 19·5	59 44·1	16 17·1	,,	,,
5 57 25·42	+19 9 6·1	59 44·0	16 17·4	,,	,,
6 20 35·78	+19 41 23·3	59 17·8	16 10·0		
6 20 35·78	+19 41 23·3	59 17·8	16 10·0		
6 20 47·65	+19 41 27·5	59 17·8	16 10·0	6 20 2·95	+20 17 59·1
6 20 47·64	+19 41 27·5	59 17·8	16 10·0	,,	,,
6 20 47·64	+19 41 27·5	59 17·8	16 10·0	,,	,,
6 23 33·02	+19 42 21·0	59 17·9	16 10·1	,,	,,
6 23 32·78	+19 42 20·9	59 17·9	16 10·1	,,	,,
8 50 38·25	+17 10 22·7	60 18·7	16 26·6	8 48 17·37	+18 3 8·1
8 50 40·98	+17 10 15·8	60 18·6	16 26·6	8 48 41·46	+17 42 58·5
1 31 58·91	+ 4 20 0·2	56 11·2	15 19·1	1 33 39·17	+ 4 43 43·1
1 31 58·91	+ 4 20 0·2	56 11·2	15 19·1	,,	,,
5 51 52·47	+19 37 46·3	59 15·3	16 9·3	5 55 1·75	+20 8 7·3
6 53 29·65	+20 5 13·8	59 56·3	16 20·4	6 55 13·28	+20 47 1·2
8 34 5·47	+18 6 3·2	59 46·7	16 17·8	8 36 10·13	+18 41 58·9
2 3 45·82	+ 7 16 1·7	57 4·5	15 33·6	2 5 6·41	+ 8 8 38·8
2 4 45·94	+ 7 21 16·5	57 5·2	15 33·9	2 5 6·41	+ 8 8 38·8
4 18 51·27	+16 56 30·1	56 55·1	15 31·1	4 16 51·83	+17 34 50·1
4 18 51·27	+16 56 30·1	56 55·1	15 31·1	,,	,,
4 18 51·28	+16 56 30·1	56 55·1	15 31·1	,,	,,
20 28 56·62	−19 9 58·2	54 15·1	14 47·4	20 31 32·77	−18 39 34·2
16 31 38·53	−17 53 31·3	57 35·8	15 42·2	16 32 58·69	−17 26 56·1
16 33 19·75	−17 58 29·2	57 34·3	15 41·7	,,	,,

131, 134. Uncertain to 2ˢ.
140. Uncertain about 1ˢ.
141. Not good.
155. The star could not be seen after contact with the bright limb.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1851.					h m s	h m s
157	May 17	μ^1 Sagittarii	D B	Merz	T. M.	20 15 18·08	15 20 30·69
158	„	„	„	Dollond	W. M.	20 15 17·22	15 20 29·83
159	May 17	μ^1 Sagittarii	R D	Merz	T. M.	21 9 22·16	16 14 25·91
160	„	„	„	Dollond	W. M.	21 9 22·28	16 14 26·03
161	May 18	ξ^1 Sagittarii	D B	Merz	T. M.	13 9 56·30	8 12 22·68
162	„	„	„	Dollond	W. M.	13 9 56·18	8 12 22·56
163	May 18	ξ^2 Sagittarii	D B	Merz	T. M.	13 26 10·80	8 28 34·52
164	„	„	„	Dollond	W. M.	13 26 10·67	8 28 34·39
165	„	„	„	Jones	G. F. C.	13 26 9·69	8 28 33·41
166	May 18	ξ^2 Sagittarii	R D	Merz	T. M.	14 0 41·01	9 2 59·08
167	„	„	„	Dollond	W. M.	14 0 40·96	9 2 59·03
168	„	„	„	Jones	G. F. C.	14 0 41·32	9 2 59·39
169	June 7	c Virginis	D D	Merz	T. M.	16 55 50·92	10 39 2·08
170	„	„	„	Dollond	W. M.	16 55 50·85	10 39 2·01
171	„	„	„	Jones	G. F. C.	16 55 51·17	10 39 2·33
172	June 17	ι Capricorni	D B	Dollond	W. M.	19 7 39·85	12 11 10·29
173	June 17	ι Capricorni	R D	Merz	T. M.	20 26 11·27	13 29 28·85
174	„	„	„	Dollond	W. M.	20 26 11·16	13 29 28·74
175	July 12	π Sagittarii	D D	Dollond	W. M.	14 9 44·15	5 35 45·62
176	Aug. 8	ξ^2 Sagittarii	D D	Merz	T. M.	17 45 28·66	7 24 45·22
177	„	„	„	Dollond	W. M.	17 45 28·67	7 24 45·23
178	Aug. 8	ξ^2 Sagittarii	R B	Merz	T. M.	19 12 17·60	8 51 19·93
179	„	„	„	Dollond	W. M.	19 12 20·94	8 51 23·26
180	Oct. 28	O. Arg. 17592	D D	Merz	T. M.	22 45 3·06	7 5 2·04
181	Oct. 28	O. Arg. 17648	D D	Merz	T. M.	23 32 13·08	7 52 4·34
182	Oct. 28	B.A.C. 6125	D D	Merz	T. M.	23 37 48·88	7 57 39·22
183	Dec. 7	ϵ Tauri	D D	Merz	T. M.	2 59 27·40	8 41 28·31
184	„	„	„	Dollond	W. M.	2 59 27·50	8 41 28·41
185	Dec. 7	ϵ Tauri	R B	Merz	T. M.	4 9 18·14	9 51 7·61
186	„	„	„	Dollond	W. M.	4 9 20·00	9 51 9·47
187	Dec. 31	ν Piscium	D D	Merz	T. M.	3 16 56·72	7 24 32·89
188	„	„	„	Dollond	W. M.	3 16 55·96	7 24 32·13
	1852.						
189	Feb. 15	o Sagittarii	D B	Dollond		13 39 30·85	14 44 33·15
190	Feb. 15	o Sagittarii	R D	Dollond		14 32 47·61	15 37 41·18
191	March 9	ξ^2 Libræ	D B	Merz	T. M.	11 57 42·40	11 32 35·51
192	„	„	„	Dollond	W. M.	11 57 40·12	11 32 33·23
193	March 9	ξ^2 Libræ	R D	Merz	T. M.	12 52 46·08	12 27 30·17
194	„	„	„	Dollond	W. M.	12 52 46·69	12 27 30·78
195	July 22	Lal. 24306	D D	Merz	T. M.	17 12 10·81	7 55 24·61
196	Sept. 17	Lal. 27713	D D	Merz	T. M.	19 20 40·86	6 19 26·82
197	Sept. 17	Lal. 27729	D D	Merz	T. M.	19 45 59·65	6 44 41·47
198	Sept. 18	Lal. 29395	D D	Merz	T. M.	18 35 26·30	5 30 23·77
199	Sept. 20	Lal. 33386	D D	Merz	T. M.	20 54 15·91	7 40 58·81
200	Sept. 23	η Capricorni	D D	Merz	T. M.	21 11 26·61	7 46 18·98
201	Oct. 20	O. Arg. 20874	D D	Merz	T. M.	22 2 4·44	6 50 39·03
202	Oct. 20	O. Arg. 20885	D D	Merz	T. M.	22 24 29·83	7 13 0·74
203	Oct. 21	O. Arg. 21591	D D	Merz	T. M.	23 7 57·19	7 52 25·08
204	Oct. 22	Lal. 43998	D D	Merz	T. M.	22 25 53·97	7 6 32·84
205	Oct. 23	ψ^3 Aquarii	D D	Merz	T. M.	21 50 12·42	6 27 1·23

157, 158, 159, 162, 164, 167, 170, 175, 176, 177, 178, 183, 184, 185, 191, 192, 193, 194, 195, 196, 197, 198, 199, 200, 201, 202. Good observations.

172. Not very accurate; star very indistinct when near the Moon's limb.

179. Not in contact with limb when first seen.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	h m s
18 5 55·99	−21 9 13·0	56 27·2	15 23·5	18 4 52·60	−21 5 28·6
18 5 55·96	−21 9 13·0	56 27·2	15 23·5	,,	,,
18 8 0·05	−21 11 9·7	56 25·6	15 23·0	,,	,,
18 8 0·05	−21 11 9·7	56 25·6	15 23·0	,,	,,
18 44 30·29	−21 29 53·2	55 58·3	15 15·6	18 48 30·36	−20 50 40·0
18 44 30·29	−21 29 53·2	55 58·3	15 15·6	,,	,,
18 45 7·06	−21 29 56·9	55 57·9	15 15·5	18 48 51·56	−21 17 44·4
18 45 7·06	−21 29 56·9	55 57·9	15 15·5	,,	,,
18 45 7·02	−21 29 56·9	55 57·9	15 15·5	,,	,,
18 46 25·13	−21 30 3·0	55 56·9	15 15·2	,,	,,
18 46 25·13	−21 30 3·0	55 56·9	15 15·2	,,	,,
18 46 25·14	−21 30 3·0	55 56·9	15 15·2	,,	,,
12 14 51·92	+ 3 29 31·3	59 6·1	16 6·8	12 12 47·64	+ 4 8 31·9
12 14 51·92	+ 3 29 31·3	59 6·1	16 6·8	,,	,,
12 14 51·93	+ 3 29 31·4	59 6·1	16 6·8	,,	,,
21 11 36·72	−17 56 15·6	54 37·5	14 53·6	21 13 57·96	−17 27 47·7
21 14 18·24	−17 47 51·6	54 36·5	14 53·3	,,	,,
21 14 18·24	−17 47 51·6	54 36·5	14 53·3	,,	,,
18 56 42·58	−21 35 47·7	55 34·2	15 9·0	19 0 56·31	−21 15 11·9
18 46 52·22	−21 35 58·5	55 25·5	15 6·6	18 48 52·65	−21 17 43·2
18 46 58·22	−21 35 58·5	55 25·5	15 6·6	,,	,,
18 50 11·43	−21 36 11·4	55 23·8	15 6·2	,,	,,
18 50 11·55	−21 36 11·4	55 23·8	15 6·2	,,	,,
17 58 51·65	−21 40 52·3	57 23·9	15 38·9	17 56 34·70	−21 8 40·2
18 0 43·36	−21 43 1·7	57 22·1	15 38·5	17 58 25·77	−21 12 38·7
18 0 56·61	−21 43 16·7	57 21·9	15 38·4	17 58 16·10	−21 27 9·3
4 18 19·35	+17 53 35·7	56 19·7	15 21·4	4 19 58·78	+18 50 48·5
4 18 19·35	+17 53 35·7	56 19·7	15 21·4	,,	,,
4 20 52·41	+18 2 25·5	56 21·4	15 21·9	,,	,,
4 20 52·48	+18 2 25·7	56 21·4	15 21·9	,,	,,
1 34 2·91	+ 4 10 40·2	54 30·1	14 51·5	1 33 43·34	+ 4 44 5·7
1 34 2·89	+ 4 10 40·1	54 30·1	14 51·5	,,	,,
18 51 28·57	−22 29 20·4	56 16·8	15 20·6	18 55 47·02	−21 57 12·1
18 53 31·39	−22 29 19·7	56 15·6	15 20·3	,,	,,
14 45 21·17	−11 17 15·1	60 1·4	16 21·8	14 48 44·98	−10 48 34·6
14 45 21·08	−11 17 14·6	60 1·4	16 21·8	,,	,,
14 47 28·90	−11 28 28·9	59 59·7	16 21·4	14 48 44·98	−10 48 34·6
14 47 28·92	−11 28 29·0	59 59·7	16 21·4	,,	,,
12 59 21·29	− 0 41 47·7	59 21·8	16 11·1	12 57 3·85	+ 0 4 3·6
15 7 37·76	−13 49 54·2	60 8·3	16 23·8	15 5 37·36	−13 27 56·2
15 8 37·50	−13 54 58·6	60 7·7	16 23·6	15 6 8·22	−13 39 9·6
16 3 2·30	−18 1 45·7	59 31·9	16 13·9	16 1 24·88	−17 56 38·2
18 5 41·43	−23 12 28·9	58 0·5	15 48·9	18 4 4·65	−23 8 51·4
20 55 22·61	−20 29 36·8	56 2·1	15 16·6	20 56 0·78	−20 26 4·5
20 40 47·48	−21 25 24·3	56 31·1	15 24·5	20 40 42·77	−21 9 48·1
20 41 38·02	−21 23 9·2	56 30·3	15 24·3	20 41 17·41	−21 8 51·7
21 35 38·15	−18 23 56·4	55 46·7	15 12·5	21 35 22·97	−18 3 28·5
22 23 33·69	−14 49 43·1	55 12·8	15 3·2	22 24 17·66	−14 21 4·9
23 9 15·43	−10 42 46·5	54 45·3	14 55·7	23 11 17·97	−10 24 55·7

186. Re-appearance not well observed; there being no wire in the field of view to guide the eye.
205. Perhaps 10ˢ later. Doubt in count.

Digitized by Google

Rotation Number	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1853.					h m s	h m s
206	April 20	ξ Virginis	D D	Merz	T. M.	10 0 34·48	6 51 35·83
207	Sept. 6	B.A.C. 4599	D D	Merz	T. M.	18 11 6·50	5 54 15·94
208	Sept. 8	Lal. 28453	D D	Merz	T. M.	19 10 4·45	6 45 12·41
209	Sept. 11	B.A.C. 6369	D D	Merz	T. M.	21 15 14·83	8 38 14·56
210	Nov. 7	B.A.C. 7378	D D	Merz	T. M.	1 16 23·03	8 54 36·51
211	Dec. 8	B.A.C. 81	D D	Merz	T. M.	3 8 54·64	8 44 56·44
	1854.						
212	March 7	B.A.C. 1896	D D	Merz	T. M.	7 19 16·55	7 4 41·29
213	March 7	B.A.C. 1896	R B	Merz	T. M.	7 53 38·03	7 38 57·14
214	March 20	*b* Ophiuchi	R D	Merz	T. M.	12 25 7·28	11 18 35·12
215	March 22	h^2 Sagittarii	D B	Merz	T. M.	13 33 43·44	12 19 8·22
216	March 22	h^2 Sagittarii	R D	Merz	T. M.	14 29 37·90	13 14 53·52
217	April 13	κ Virginis	D B	Merz	T. M.	12 2 45·44	9 21 55·16
218	April 13	κ Virginis	R D	Merz	T. M.	13 9 29·78	10 28 28·57
219	April 15	ω^1 Scorpii	R D	Merz	T. M.	13 29 4·01	10 40 7·78
220	„	„	„	Dollond	G. M.	13 29 4·31	10 40 8·08
221	May 7	W.B. XI. 175	D D	Merz	T. M.	11 11 7·90	6 56 4·27
222	May 11	B.A.C. 4828	D D	Merz	T. M.	9 34 54·51	5 4 22·99
223	May 11	B.A.C. 4890	D D	Merz	T. M.	17 15 59·07	12 44 12·02
224	„	„	„	Dollond	G. M.	17 15 59·43	12 44 12·38
225	May 11	B.A.C. 4890	R B	Dollond	G. M.	18 14 28·27	13 42 31·64
226	May 22	μ Piscium	D B	Merz	T. M.	22 24 53·43	17 9 2·75
227	„	„	„	Dollond	G. M.	22 24 52·61	17 9 1·93
228	June 7	κ Virginis	D D	Merz	T. M.	11 44 6·91	5 27 4·62
229	„	„	„	Dollond	G. M.	11 44 10·63	5 27 8·33
230	June 7	κ Virginis	R B	Merz	T. M.	12 40 37·04	6 23 25·49
231	„	„	„	Dollond	G. M.	12 40 36·10	6 23 24·55
232	June 14	κ Capricorni	D B	Merz	T. M.	16 23 33·04	9 38 13·59
233	„	„	„	Dollond	G. M.	16 23 31·58	9 38 12·13
234	June 14	κ Capricorni	R D	Merz	T. M.	17 18 0·68	10 32 32·31
235	„	„	„	Dollond	G. M.	17 18 0·80	10 32 32·43
236	June 28	77 Cancri	D D	Merz	T. M.	13 6 35·24	5 26 45·28
237	June 28	79 Cancri	D D	Merz	T. M.	13 47 17·45	6 7 20·82
238	July 5	μ Libræ	D D	Merz	T. M.	16 52 57·62	8 44 59·19
239	„	„	„	Dollond	G. M.	16 52 57·50	8 44 59·07
240	July 5	μ Libræ	R B	Dollond	G. M	17 23 44·78	9 15 41·30
241	July 13	ψ^3 Aquarii	D B	Merz	T. M.	22 6 50·99	13 26 33·84
242	„	„	„	Dollond	G. M.	22 6 46·48	13 26 29·33
243	July 13	ψ^3 Aquarii	R D	Merz	T. M.	23 15 28·70	14 35 0·31
244	„	„	„	Dollond	G. M.	23 15 30·04	14 35 1·65
245	July 29	Lal. 22678	D D	Merz	T. M.	14 59 14·77	5 17 13·09
246	„	„	„	Dollond	G. M.	14 59 15·73	5 17 14·05
247	Aug. 8	κ Capricorni	D B	Merz	T. M.	16 5 7·64	5 43 36·06
248	„	„	„	Dollond	G. M.	16 5 4·44	5 43 32·87
249	Aug. 8	κ Capricorni	R D	Merz	T. M.	17 4 44·95	6 43 3·61
250	„	„	„	Dollond	G. M.	17 4 47·90	6 43 6·56
251	Sept. 1	B.A.C. 6138	D D	Merz	T. M.	21 6 52·79	9 10 9·96

209, 211, 213, 214, 215, 216, 217, 218, 228, 243, 245. Good observations.
241. Disappeared seemingly on touching.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
11 35 34·70	+ 8 13 21·1	59 22·1	16 11·1	11 37 43·16	+ 9 4 26·7
13 42 34·81	− 6 35 5·8	59 4·6	16 6·4	13 40 37·05	− 6 6 6·6
15 32 21·72	−17 22 25·3	59 20·2	16 10·6	15 30 21·01	−17 10 45·8
18 37 12·82	−25 12 37·9	58 59·3	16 4·9	18 35 49·17	−25 9 12·4
21 10 17·79	−21 12 33·3	58 12·2	15 52·1	21 8 21·25	−20 46 48·8
0 18 20·73	− 3 21 22·1	55 59·9	15 16·1	0 17 1·32	− 3 1 43·4
5 49 46·93	+25 24 15·3	54 13·3	14 46·9	5 48 55·99	+25 55 56·1
5 51 1·37	+25 25 54·4	54 13·1	14 46·9	5 48 55·99	+25 55 56·1
17 15 9·23	−24 30 10·4	59 12·4	16 8·5	17 17 27·35	−24 2 13·8
19 22 59·67	−25 44 32·2	59 12·2	16 8·4	19 27 48·38	−25 12 9·3
19 25 25·04	−25 41 51·3	59 12·0	16 8·4	19 27 48·38	−25 12 9·3
14 2 59·00	− 9 46 16·2	59 5·8	16 6·7	14 5 7·89	− 9 35 39·1
14 5 24·40	−10 2 34·0	59 7·2	16 7·1	14 5 7·89	− 9 35 39·1
15 57 10·22	−20 26 9·5	59 44·6	16 17·3	15 58 17·38	−20 16 17·5
15 57 10·23	−20 26 9·6	59 44·6	16 17·3	,,	,,
11 10 27·90	+10 53 39·8	56 22·9	15 22·3	11 11 15·98	+11 23 38·6
14 24 54·14	−12 9 47·6	59 39·2	16 15·8	14 29 15·44	−11 41 4·1
14 42 22·32	−13 58 41·5	59 51·5	16 19·2	14 41 20·66	−13 32 25·1
14 42 22·33	−13 58 41·6	59 51·5	16 19·2	,,	,,
14 44 36·95	−14 12 14·1	59 52·8	16 19·6	14 41 20·66	−13 32 25·1
1 19 37·55	+ 4 38 24·4	56 2·9	15 16·8	1 22 31·54	+ 5 23 20·4
1 19 37·52	+ 4 38 24·2	56 2·9	15 16·8	,,	,,
14 2 59·23	− 9 45 29·3	59 0·4	16 5·2	14 5 8·29	− 9 35 39·0
14 2 59·36	− 9 45 30·2	59 0·4	16 5·2	,,	,,
14 5 1·24	− 9 59 14·1	59 2·6	16 5·8	14 5 8·29	− 9 35 39·0
14 5 1·21	− 9 59 14·3	59 2·6	16 5·8	,,	,,
21 30 14·11	−20 10 33·3	59 50·7	16 18·9	21 34 31·29	−19 31 40·1
21 30 14·05	−20 10 33·6	59 50·7	16 18·9	,,	,,
21 32 26·93	−20 0 44·0	59 48·9	16 18·4	21 34 31·29	−19 31 40·1
21 32 26·93	−20 0 44·0	59 48·9	16 18·4	,,	,,
9 2 46·10	+21 58 11·5	54 12·0	14 46·6	9 0 57·08	+22 38 4·7
9 4 9·95	+21 52 58·9	54 12·4	14 46·7	9 1 56·84	+22 35 15·8
14 42 19·35	−14 4 56·1	58 55·5	16 3·9	14 41 20·63	−13 32 24·5
14 42 19·35	−14 4 56·1	58 55·5	16 3·9	,,	,,
14 43 27·63	−14 11 47·2	58 56·5	16 4·2	14 41 20·63	−13 32 24·5
23 9 22·29	−10 49 25·0	59 13·2	16 8·7	23 11 23·48	−10 24 19·5
23 9 22·13	−10 49 26·1	59 13·2	16 8·7	,,	,,
23 11 51·93	−10 32 51·0	59 10·6	16 8·0	23 11 23·48	−10 24 19·5
23 11 51·98	−10 32 50·7	59 10·6	16 8·0	,,	,,
11 58 20·32	+ 4 59 52·6	55 38·4	15 10·2	11 58 20·32	+ 4 59 52·6
11 58 20·35	+ 4 59 52·4	55 38·4	15 10·2	,,	,,
21 29 48·08	−20 1 45·2	60 52·5	16 35·8	21 34 32·58	−19 31 36·0
21 29 47·95	−20 1 45·8	60 52·5	16 35·8	,,	,,
21 32 20·49	−19 50 20·5	60 51·6	16 35·5	21 34 32·58	−19 31 36·0
21 32 20·61	−19 50 19·9	60 51·6	16 35·5	,,	,,
18 1 41·09	−26 20 38·3	59 36·8	16 15·1	18 0 13·16	−26 7 18·4

244. Not very certain; observer pressed for time after observing the Moon's Transit.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1854.					h m s	h m s
252	Sept. 2	B.A.C. 6562	D D	Merz	T. M.	20 35 11·98	8 34 38·44
253	Sept. 2	B.A.C. 6562	R B	Merz	T. M.	21 46 51·96	9 46 6·67
254	Sept. 2	B.A.C. 6578	D D	Merz	T. M.	22 17 57·01	10 17 6·63
255	Oct. 29	κ Capricorni	D D	Merz	T. M.	23 32 30·07	7 47 20·72
256	Nov. 27	ψ^2 Aquarii	D D	Merz	T. M.	1 55 3·58	8 15 29·48
257	"	"	"	Dollond	G. M.	1 55 4·26	8 15 30·16
258	Nov. 27	ψ^2 Aquarii	R B	Merz	T. M.	3 1 14·06	9 21 29·12
	1855.						
259	Jan. 3	υ Geminorum	R D	Merz	T. M.	6 35 56·12	10 30 7·25
260	April 4	α^1 Libræ	R D	Merz	T. M.	14 45 14·76	12 40 17·96
261	April 4	α^2 Libræ	D B	Merz	T. M.	13 33 15·85	11 28 30·84
262	April 4	α^2 Libræ	R D	Merz	T. M.	14 55 55·30	12 50 56·75
263	April 8	ϕ Sagittarii	D B	Merz	T. M.	15 0 4·29	12 39 21·43
264	April 8	ϕ Sagittarii	R D	Merz	T. M.	16 2 6·00	13 41 12·98
265	May 8	ϵ Capricorni	D B	Merz	T. M.	18 19 47·38	14 0 34·53
	1856.						
266	April 25	τ Sagittarii	D B	Merz	T. M.	17 40 23·31	14 9 24·68
267	April 25	τ Sagittarii	R D	Merz	T. M.	19 10 48·76	15 39 35·32
268	Sept. 8	B.A.C. 6127	D D	Merz	T. M.	20 20 36·18	7 54 27·39
269	Sept. 8	B.A.C. 6127	R B	Merz	T. M.	21 23 1·35	8 56 42·33
270	Nov. 12	η Tauri	D B	Merz	W. M.	0 25 8·24	7 42 45·33
271	Nov. 12	η Tauri	R D	Merz	W. M.	1 29 59·81	8 47 26·27
	1857.						
272	Jan. 15	η Virginis	D B	Merz	G. M.	9 40 31·06	12 44 58·76
273	Jan. 15	η Virginis	R D	Merz	G. M.	10 33 38·24	13 37 57·24
274	Feb. 6	ϕ Geminorum	D D	Merz	W. M.	9 24 59·94	11 3 0·14
275	March 16	σ Scorpii	D B	Merz	W. M.	11 55 40·21	11 3 51·19
276	March 16	σ Scorpii	R D	Merz	W. M.	12 55 29·55	12 3 30·73
277	March 16	α Scorpii	D B	Merz	G. M.	17 36 59·58	16 44 14·64
278	March 18	B.A.C. 6127	D D	Merz	W. M.	11 34 36·92	10 34 59·53
279	March 18	B.A.C. 6127	R D	Merz	W. M.	11 45 6·24	10 45 27·14
280	March 19	τ Sagittarii	R D	Merz	W. M.	12 46 19·96	11 42 34·92
281	March 31	κ Aurigæ	D D	Merz	G. M.	9 58 7·50	8 7 39·13
282	April 29	ϕ Geminorum	D D	Merz	W. M.	9 1 20·41	5 16 59·98
283	May 31	β Virginis	D D	Merz	G. M.	16 5 19·66	10 14 0·61
284	June 6	α Scorpii	D D	Merz	W. M.	17 50 38·18	11 35 26·40
285	July 27	α Virginis	D D	Merz	G. M.	15 47 21·72	6 11 58·60
286	Nov. 23	γ Capricorni	D D	Merz	G. M.	23 12 34·67	5 48 5·41
287	Nov. 23	γ Capricorni	R B	Merz	G. M.	0 22 11·75	6 57 31·09
	1858.						
288	March 6	α Scorpii	D B	Merz	G. M.	10 5 46·44	9 54 31·30
289	March 6	α Scorpii	R D	Merz	G. M.	11 0 9·02	10 48 44·98
290	Oct. 12	3 Sagittarii	D D	Merz	G. M.	23 36 41·05	8 58 12·87
291	Oct. 14	h^2 Sagittarii	D D	Merz	W. M.	1 18 7·82	10 31 31·20

260, 261, 262, 266, 267, 268, 274, 276, 277, 278, 279, 280, 281, 282, 283, 285, 288, 291. Good observations.
269. Probably uncertain one second, owing to haze.
270, 271. Cloudy: the star very faint, but fair observations.
275. Limb undulating, and star dimmed by cloud: a fair observation.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
19 4 40·33	−26 27 17·4	60 2·6	16 22·2	19 4 16·36	−26 8 50·6
19 7 53·79	−26 24 49·6	60 3·6	16 22·5	″	″
19 9 17·71	−26 23 40·4	60 4·2	16 22·6	19 7 15·35	−25 54 59·8
21 35 13·43	−19 55 31·6	59 1·6	16 5·5	21 34 32·22	−19 31 40·0
23 11 30·33	−10 29 51·8	58 25·5	15 55·7	23 10 21·09	− 9 58 33·5
23 11 30·35	−10 29 51·6	58 25·5	15 55·7	″	″
23 13 49·61	−10 13 50·5	58 24·1	15 55·3	23 10 21·09	− 9 58 33·5
7 27 15·21	+26 20 4·4	54 4·5	14 44·5	7 26 59·66	+27 12 52·8
14 43 26·49	−15 53 5·2	56 49·5	15 29·5	14 42 41·50	−15 23 39·1
14 40 56·42	−15 37 53·3	56 47·9	15 29·1	14 42 52·93	−15 26 20·9
14 43 48·79	−15 55 19·9	56 49·6	15 29·6	14 42 52·93	−15 26 20·9
18 32 31·88	−27 30 27·7	58 42·4	16 0·3	18 36 36·12	−27 8 11·0
18 35 13·46	−27 30 15·3	58 43·5	16 0·6	18 36 36·12	−27 8 11·0
21 25 49·09	−20 40 14·2	59 17·7	16 9·9	21 28 57·80	−20 6 48·4
18 55 36·17	−28 1 47·6	57 14·0	15 36·2	18 57 58·13	−27 52 39·4
18 59 20·51	−27 57 47·2	57 16·3	15 36·8	18 57 58·13	−27 52 39·4
18 0 3·41	−28 29 52·1	56 41·4	15 27·3	17 59 0·48	−28 28 16·5
18 2 36·19	−28 30 36·5	56 43·5	15 27·9	″	″
3 35 5·44	+22 52 2·2	60 42·2	16 33·0	3 38 59·88	+23 39 43·0
3 37 52·28	+23 4 2·6	60 40·9	16 32·6	3 38 59·88	+23 39 43·0
12 9 45·20	− 0 25 1·5	54 37·1	14 53·4	12 12 35·94	+ 0 7 37·5
12 11 18·44	− 0 37 39·7	54 36·3	14 53·2	12 12 35·94	+ 0 7 37·5
7 45 10·02	+26 14 59·7	57 18·8	15 37·5	7 44 46·22	+27 8 0·6
16 8 25·11	−25 35 25·6	54 25·9	14 50·4	16 12 31·18	−25 14 53·9
16 10 33·17	−25 42 17·9	54 26·8	14 50·6	16 12 31·18	−25 14 53·9
16 20 39·91	−26 13 6·5	54 30·9	14 51·7	16 20 39·72	−26 6 47·4
17 55 33·14	−28 42 19·8	55 24·6	15 6·4	17 59 2·26	−28 28 13·4
17 55 57·82	−28 42 25·9	55 24·9	15 6·4	17 59 2·26	−28 28 13·4
18 55 8·04	−28 8 29·4	56 10·4	15 18·9	18 58 1·01	−27 52 36·8
6 8 22·64	+28 43 26·8	58 26·3	15 55·9	6 6 16·46	+29 32 57·2
7 44 45·04	+26 19 24·5	57 57·3	15 48·0	7 44 45·18	+27 8 4·0
11 46 0·01	+ 2 17 52·9	54 53·1	14 57·8	11 43 16·32	+ 2 34 4·1
16 21 5·66	−26 6 38·9	54 21·6	14 49·2	16 20 41·57	−26 6 52·5
13 19 8·14	−10 34 45·0	54 36·0	14 53·1	13 17 41·32	−10 25 2·0
21 32 32·27	−17 38 21·2	56 7·1	15 18·0	21 32 12·66	−17 18 14·4
21 34 54·07	−17 24 6·3	56 9·3	15 18·5	21 32 12·66	−17 18 14·4
16 16 15·97	−26 35 18·3	54 15·3	14 47·5	16 20 43·46	−26 6 55·8
16 18 13·52	−26 40 23·5	54 15·1	14 47·4	16 20 43·46	−26 6 55·8
17 41 1·37	−28 17 52·9	54 17·8	14 48·2	17 38 40·19	−27 46 31·2
19 30 22·46	−25 41 2·9	54 18·2	14 48·3	19 28 7·13	−25 11 37·2

284. Sky heavily clouded, and a violent N. wind blowing. The star was seen faintly for about 3ˢ only before its disappearance.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1859.					h m s	h m s
292	Jan. 21	c Leonis	D B	Merz	W. M.	5 55 24·38	8 38 47·11
293	Jan. 21	c Leonis	R D	Merz	W. M.	6 57 32·73	9 40 45·28
294	Feb. 8	η Piscium	D D	Merz	W. M.	6 27 11·04	7 59 42·17
295	Feb. 11	ϕ Tauri	D D	Merz	W. M.	8 3 33·00	9 24 0·61
296	May 13	ψ Virginis	D B	Merz	W. M.	10 6 46·40	5 29 6·14
297	May 13	ψ Virginis	R B	Merz	W. M.	10 36 45·20	5 59 0·02
298	Aug. 18	η Piscium	D B	Merz	W. M.	22 8 21·45	11 7 19·53
299	Aug. 18	η Piscium	R D	Merz	W. M.	22 22 3·70	11 20 59·55
300	Oct. 28	α Scorpii	D D	Merz	W. M.	20 7 12·80	4 27 21·25
301	Oct. 28	α Scorpii	R B	Merz	W. M.	21 11 46·46	5 31 44·33
302	Nov. 8	η Piscium	D D	Merz	W. M.	23 38 31·48	7 14 50·28
303	Nov. 8	η Piscium	R B	Merz	W. M.	0 39 56·75	8 16 5·50
304	Dec. 21	σ Scorpii	D B	Merz	G. M.	10 1 32·26	14 47 4·81
305	Dec. 21	α Scorpii	D B	Merz	W. M.	14 17 49·06	19 2 39·62
	1860.						
306	Jan. 12	υ Leonis	D B	Merz	W. M.	9 38 16·53	12 57 10·71
307	Feb. 13	A Scorpii	D B	Merz	W. M.	14 33 57·94	15 46 26·63
308	March 7	υ Leonis	D B	Merz	W. M.	9 52 14·06	9 35 3·02
309	March 7	υ Leonis	R D	Merz	W. M.	10 51 37·92	10 34 17·15
310	March 12	σ Scorpii	D B	Merz	W. M.	10 18 8·51	9 41 13·69
311	March 12	Wash. 6752	R D	Merz	W. M.	11 9 26·28	10 32 23·05
312	March 12	σ Scorpii	R D	Merz	W. M.	11 9 56·97	10 32 53·66
313	March 12	α Scorpii	D B	Merz	W. M.	14 38 24·75	14 0 47·29
314	,,	,,	,,	Dollond	G. M.	14 38 25·04	14 0 47·58
315	March 12	α Scorpii	R D	Dollond	G. M.	15 53 54·44	15 16 4·61
316	March 28	B.A C. 1648	D D	Merz	T. M.	8 36 26·86	6 56 54·18
317	April 26	Lal. 13554	D D	Merz	T. M.	8 20 56·53	4 47 25·04
318	April 27	μ^2 Cancri	D D	Merz	T. M.	12 20 53·43	8 42 46·73
319	May 1	υ Leonis	D D	Merz	T. M.	8 31 23·60	4 38 10·86
320	May 1	υ Leonis	R B	Merz	T. M.	9 39 28·77	5 46 4·87
321	May 8	λ Sagittarii	R D	Merz	T. M.	13 13 56·30	8 52 25·90
322	May 25	δ Cancri	D D	Merz	T. M.	11 17 29·93	5 49 28·12
323	May 25	δ Cancri	R B	Merz	T. M.	12 20 12·21	6 52 0·13
324	June 3	A^1 Ophiuchi	D B	Merz	T. M.	20 2 49·68	13 57 58·60
325	June 3	A^2 Ophiuchi	D B	Merz	T. M.	20 2 50·68	13 57 59·60
326	June 3	A^1 Ophiuchi	R D	Merz	T. M.	21 8 20·67	15 3 18·86
327	June 3	A^2 Ophiuchi	R D	Merz	T. M.	21 8 23·67	15 3 21·85
328	Aug. 24	A^1, A^2 Ophiuchi	D D	Merz	W. M.	20 51 45·66	9 24 21·84
329	Aug. 30	θ Aquarii	R D	Merz	W. M.	18 0 2·70	6 9 31·54
330	Oct. 17	22 Scorpii	D D	Merz	W. M.	22 15 57·19	7 16 0·55
331	,,	,,	,,	Dollond	T. M.	22 15 57·46	7 16 0·81
332	Nov. 17	Lal. 38096	D D	Merz	T. M.	0 12 20·44	7 10 11·55
333	Nov. 19	Lal. 42073	D D	Merz	T. M.	23 21 14·58	6 11 22·24
334	Nov. 19	Lal. 42160	D D	Merz	T. M.	1 51 6·23	8 40 49·34
335	Nov. 21	Lal. 45233	D D	Merz	T. M.	2 2 37·10	8 44 26·49
336	Nov. 22	Lal. 46737	D D	Merz	T. M.	2 11 29·69	8 49 21·73

292. Moon low and limb undulating.

293, 298, 299, 300, 301, 302, 304, 305, 306, 307, 308, 318, 319, 332. Good observations.

294. Moon very low and star faintly seen through stratus; but a good observation.

296. The star disappeared at the imperfectly illuminated border of the moon, and near to the South point; it appeared to enter a wide cavity, and advanced till finally eclipsed behind the shoulder of one of the sides of the opening, at a distance of 10″ or 15″ from the extreme outer visible point.

303. Not satisfactory.

305. Bright sunshine: disappearance instantaneous.

310. Limb undulating: the observation about as precise as practicable under the circumstances.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
10 49 12·52	+ 6 21 47·8	59 51·3	16 19·1	10 53 27·96	+ 6 51 20·7
10 51 25·94	+ 6 4 34·5	59 49·0	16 18·5	10 53 27·96	+ 6 51 20·7
1 26 41·92	+13 49 17·2	56 41·4	15 27·3	1 23 56·84	+14 37 10·3
4 14 18·84	+26 34 23·9	58 55·5	16 3·9	4 11 42·61	+27 0 47·6
12 45 14·13	− 8 57 22·6	57 39·1	15 43·1	12 47 3·98	− 8 46 39·2
12 46 15·02	− 9 4 49·0	57 38·5	15 42·9	12 47 3·98	− 8 46 39·2
1 22 3·08	+13 46 2·4	55 43·4	15 11·5	1 23 59·98	+14 37 24·6
1 22 29·85	+13 48 58·4	55 43·7	15 11·6	1 23 59·98	+14 37 24·6
16 22 38·66	−26 18 54·5	56 46·8	15 28·8	16 20 48·49	−26 7 7·5
16 25 13·63	−26 23 28·4	56 44·8	15 28·3	16 20 48·49	−26 7 7·5
1 22 23·40	+13 41 38·0	56 17·9	15 20·9	1 24 1·11	+14 37 33·4
1 24 27·29	+13 54 52·1	56 19·5	15 21·3	1 24 1·11	+14 37 33·4
16 8 5·97	−25 47 44·2	56 23·1	15 22·3	16 12 40·41	−25 15 14·2
16 18 10·48	−26 7 24·1	56 18·0	15 20·9	16 20 49·06	−26 7 6·3
11 27 55·32	− 0 20 46·5	59 47·9	16 18·1	11 29 48·42	− 0 3 12·2
15 43 16·95	−24 54 22·0	56 53·0	15 30·5	15 45 14·01	−24 54 28·1
11 28 8·52	− 0 21 8·2	61 17·9	16 42·7	11 29 49·51	− 0 3 20·1
11 30 22·35	− 0 38 15·7	61 17·2	16 42·5	11 29 49·51	− 0 3 20·1
16 8 2·76	−25 45 38·6	57 20·9	15 38·1	16 12 43·10	−25 15 20·7
16 10 6·68	−25 49 49·9	57 19·2	15 37·6	16 12 41·61	−25 15 19·1
16 10 7·91	−25 49 52·3	57 19·1	15 37·6	16 12 43·10	−25 15 20·7
16 18 31·40	−26 5 42·3	57 11·1	15 35·4	16 20 51·75	−26 7 12·1
16 18 31·41	−26 5 42·3	57 11·1	15 35·4	16 20 51·75	−26 7 12·1
16 21 33·72	−26 10 58·3	57 8·2	15 34·6	16 20 51·75	−26 7 12·1
5 14 12·23	+26 55 17·7	57 6·5	15 34·2	5 12 13·39	+27 48 48·1
6 54 13·25	+24 56 8·7	57 57·3	15 48·1	6 53 45·79	+25 33 48·1
8 1 40·09	+21 14 46·0	58 33·9	15 58·0	7 59 33·14	+21 59 6·4
11 26 52·25	− 0 23 7·1	60 0·6	16 21·6	11 29 49·46	− 0 3 20·9
11 29 19·48	− 0 41 38·3	60 0·8	16 21·7	,,	,,
18 16 57·60	−26 1 29·3	56 36·9	15 26·1	18 19 23·13	−25 29 45·0
8 38 17·37	+18 9 50·5	58 52·4	16 3·0	8 36 45·12	+18 39 56·0
8 40 41·70	+17 57 26·7	58 53·0	16 3·2	,,	,,
17 8 9·85	−26 32 10·9	57 24·7	15 39·2	17 6 48·62	−26 23 43·8
17 8 9·89	−26 32 10·9	57 24·7	15 39·2	17 6 48·81	−26 23 40·0
17 10 52·75	−26 33 2·0	57 23·0	15 38·7	17 6 48·62	−26 23 43·8
17 10 52·87	−26 33 2·0	57 23·0	15 38·7	17 6 48·81	−26 23 40·0
17 8 44·76	−26 32 7·3	56 49·1	15 29·4	{ 17 6 48·62 { 17 6 48·81	{ −26 23 43·8 { −26 23 40·0
22 7 46·49	− 8 50 34·2	54 10·9	14 46·3	22 9 31·06	− 8 28 21·9
16 24 34·28	−25 29 27·8	58 59·2	16 4·9	16 21 45·18	−24 48 23·5
16 31 34·31	−25 29 27·8	58 59·2	16 4·9	,,	,,
19 54 21·58	−20 40 11·1	56 20·3	15 21·6	19 52 24·58	−20 14 4·6
21 30 17·80	−12 22 29·5	55 0·0	14 59·7	21 29 50·18	−12 4 54·1
21 35 2·54	−11 52 44·2	54 56·6	14 58·8	21 31 59·94	−11 12 2·0
23 2 41·47	− 1 47 1·4	54 13·5	14 47·0	23 0 38·86	− 1 2 43·9
23 45 23·46	+ 3 24 5·8	54 8·5	14 45·6	23 44 35·03	+ 3 55 34·3

312. Not instantaneous. The time recorded is that of the first appearance of light, which was followed at an interval of about $0^s\cdot5$ by the full blaze of the star.

317. Dense haze at times: the star not very distinct, but sufficiently visible at the instant of disappearance.

320. Uncertain whether time should not be 10^s later.

323, 324. Bad observations owing to the violent working of the moon's limb.

328. Both stars eclipsed sensibly at the same moment.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1860.					h m s	h m s
337	Nov. 22	Lal. 46742	D D	Merz	T. M.	2 22 28·19	9 0 18·43
338	Nov. 24	Lal. 2312	D D	Merz	T. M.	23 48 32·84	6 18 56·47
339	Nov. 27	Piazzi III. 175	D D	Merz	T. M.	1 53 59·53	8 12 14·87
340	Nov. 27	Lal. 7114	D D	Merz	T. M.	2 24 34·63	8 42 44·96
	1862.						
341	Dec. 7	μ Geminorum	D B	Merz	T. M.	4 10 40·08	9 51 8·12
342	Dec. 7	μ Geminorum	R D	Merz	T. M.	5 46 32·56	11 26 44·89
343	Dec. 13	p^5 Leonis	D B	Merz	T. M.	7 12 1·19	12 28 24·05
344	Dec. 13	p^5 Leonis	R D	Merz	T. M.	8 26 18·43	13 42 29·12
	1863.						
345	Jan. 27	ζ Arietis	D D	Merz	W. M.	5 40 34·05	8 0 15·87
346	March 12	58 Ophiuchi	R D	Merz	W. M.	10 54 44·63	10 20 35·03
347	April 7	ω Ophiuchi	D B	Merz	W. M.	13 50 25·24	11 33 33·29
348	April 8	58 Ophiuchi	D B	Merz	W. M.	19 7 15·44	16 45 35·68
349	April 8	58 Ophiuchi	R D	Merz	W. M.	20 25 7·90	18 3 15·39
350	May 4	ω^2 Scorpii	D B	Merz	W. M.	14 20 16·89	10 17 10·54
351	June 28	ω^2 Scorpii	D D	Merz	W. M.	14 29 45·40	6 50 22·40
352	June 28	^{2} Scorpii	R B	Merz	W. M.	15 11 3·64	7 31 33·88
353	June 30	21 Sagittarii	D D	Merz	W. M.	18 41 47·00	10 53 50·89
354	June 30	21 Sagittarii	R B	Merz	W. M.	19 53 9·69	12 5 1·88
355	July 2	β Capricorni	R D	Merz	W. M.	14 17 20·48	6 22 15·87
356	Nov. 17	Wash. 9439	D D	Merz	W. M.	3 10 23·84	10 10 37·24
357	Nov. 17	ξ Aquarii	D D	Merz	W. M.	3 24 46·30	10 24 57·34
	1864.						
358	Feb. 29	ψ Ophiuchi	D B	Merz	W. M.	13 44 7·74	13 53 42·12
359	Feb. 29	ψ Ophiuchi	R D	Merz	W. M.	15 7 17·98	15 16 38·74
360	March 24	α Virginis	D B	Merz	W. M.	11 42 29·26	10 18 1·82
361	March 24	α Virginis	R D	Merz	W. M.	13 2 21·21	11 37 40·70
362	March 27	ν^2 Scorpii	D B	Merz	W. M.	17 16 11·72	15 39 1·89
363	March 27	B.A.C. 5383	R D	Merz	W. M.	18 12(38·)	16 35(19·)
364	March 27	ν^2 Scorpii	R D	Merz	W. M.	18 15 22·24	16 38 2·72
365	April 27	e^2 Sagittarii	D B	Merz	W. M.	14 37 15·04	10 58 38·13
366	April 27	e^2 Sagittarii	R D	Merz	W. M.	15 34 5·91	11 55 19·69
367	July 18	e^2 Sagittarii	D	Merz	G. M.	21 22 6·73	12 19 58·84
368	July 18	e^2 Sagittarii	R	Merz	G. M.	22 29 42·28	13 27 23·31
369	Dec. 6	κ Piscium	D D	Merz	W. M.	0 26 9·02	6 9 7·95
370	Dec. 6	κ Piscium	R B	Merz	W. M.	1 42 47·07	7 25 33·44
371	Dec. 13	χ^4 Orionis	D B	Merz	G. M.	1 35 42·52	6 50 58·67
372	Dec. 13	χ^4 Orionis	R D	Merz	G. M.	2 48 6·30	8 3 10·59

339. Indifferent observation,

340, 345, 347, 348, 350, 351, 352, 356, 357, 358, 359, 360, 361, 362, 366, 367, 368, 369, 370. Good observations.

341. Uncertain 1^s or 2^s. The star very faint owing to strong daylight, and the Moon's limb undulating.

347. The Moon's bright limb beautifully defined, and the star distinctly seen up to the instant of disappearance.

348. Moon's limb sharply defined.

349. Not so certain of the precise instant; the Sun was an hour above the horizon, and the star very faint in consequence.

350. Splendid definition.

353. Uncertain 2^s.

355. Not precise, owing to the extreme faintness of the object; the Moon low, and partly obscured by cloud and trees.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
23 45 42·91	+ 3 26 26·3	54 8·4	14 45·6	23 44 48·15	+ 3 58 28·3
1 8 12·24	+12 45 26·2	54 22·8	14 49·6	1 10 12·77	+13 30 45·1
3 40 31·24	+22 55 10·5	55 34·6	15 9·1	3 43 8·21	+24 44 33·8
3 41 39·97	+23 58 2·7	55 35·2	15 9·3	3 43 55·07	+24 45 3·4
6 11 59·95	+21 54 1·5	53 57·8	14 42·7	6 14 42·65	+22 34 45·9
6 15 21·89	+21 48 44·9	53 58·0	14 42·8	6 14 42·65	+22 34 45·9
11 3 19·85	+ 0 18 58·4	56 18·1	15 21·0	11 6 45·78	+ 0 40 36·0
11 5 45·15	+ 0 3 45·1	56 20·5	15 21·6	11 6 45·78	+ 0 40 36·0
3 8 0·06	+19 50 44·9	54 46·2	14 55·9	3 7 3·72	+20 32 9·4
17 32 55·49	−22 8 23·1	59 11·2	16 8·1	17 35 15·20	−21 36 45·6
16 20 52·66	−21 35 5·4	59 17·8	16 10·0	16 24 4·19	−21 10 16·1
17 35 30·20	−21 53 4·7	59 23·0	16 11·4	17 35 16·04	−21 36 45·8
17 38 48·56	−21 50 56·5	59 22·9	16 11·3	17 35 16·04	−21 36 45·8
15 57 15·55	−20 58 23·2	59 59·2	16 21·2	15 59 26·17	−20 29 51·3
15 57 16·51	−20 56 46·0	60 7·0	16 23·4	15 59 26·61	−20 29 51·6
15 59 3·33	−20 59 34·8	60 8·3	16 23·7	15 59 26·61	−20 29 51·6
18 16 42·00	−21 0 38·0	61 17·5	16 42·6	18 17 15·86	−20 36 34·6
18 19 54·25	−20 55 34·3	61 18·2	16 42·8	18 17 15·86	−20 36 34·6
20 10 59·53	−15 41 18·5	61 9·8	16 40·5	20 13 22·73	−15 12 24·4
21 32 12·45	− 9 3 46·2	59 8·6	16 7·4	21 29 53·82	− 8 25 17·2
21 32 44·68	− 9 1 0·6	59 8·4	16 7·4	21 30 30·93	− 8 27 37·3
16 13 0·36	−19 56 44·5	57 31·9	15 41·1	16 16 10·70	−19 42 57·5
16 16 15·70	−20 0 58·3	57 34·6	15 41·8	16 16 10·70	−19 42 57·5
13 16 11·87	−10 37 46·5	55 32·7	15 8·6	13 18 4·76	−10 27 16·2
13 18 53·48	−10 50 17·5	55 34·2	15 9·0	13 18 4·76	−10 27 16·2
16 4 21·66	−19 31 59·8	57 9·9	15 35·1	16 4 8·31	−19 6 18·3
16 6 38·80	−19 35 22·6	57 11·5	15 35·5	16 4 8·31	−19 6 18·3
19 30 35·54	−17 3 16·1	58 54·1	16 3·5	19 34 46·56	−16 26 13·6
19 32 51·19	−16 56 47·0	58 54·8	16 3·7	19 34 46·56	−16 26 13·6
19 35 31·47	−16 56 32·0	60 36·7	16 31·5	19 34 48·43	−16 26 6·4
19 38 22·99	−16 48 16·9	60 38·0	16 31·8	19 34 48·43	−16 26 6·4
23 19 55·15	− 0 6 35·9	59 13·2	16 8·7	23 20 1·23	+ 0 31 6·9
23 22 44·76	+ 0 8 32·9	59 13·2	16 8·7	23 20 1·23	+ 0 31 6·9
5 51 47·66	+19 31 40·5	57 3·0	15 33·2	5 55 56·14	+20 8 10·3
5 54 36·31	+19 29 50·6	57 1·1	15 32·7	5 55 56·14	+20 8 10·3

363. Not certain. Re-appearance not instantaneous.

364. The re-appearance not instantaneous. The star acquired its full brightness gradually, and in about a second of time. This was remarked at the appearance of the faint star (363) and attention was particularly directed to this point at the re-appearance of the bright star.

365. Moon's limb boiling; the observation not precise.

370. Limb ragged.

371. Diffused and boiling.

372. Perhaps 1ˢ too late; attention drawn off.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1865.					h m s	h m s
373	March 14	*h* Virginis	D B	Merz	G. M.	16 2 2·08	15 17 8·58
374	March 15	λ Virginis	D B	Merz	G. M.	15 22 5·37	14 33 22·50
375	March 15	λ Virginis	R D	Merz	G. M.	16 23 14·37	15 34 21·49
376	May 10	ζ^1 Libræ	D B	Merz	W. M.	16 46 45·17	12 17 37·65
377	May 10	ζ^1 Libræ	R D	Merz	W. M.	18 9 19·70	13 39 58·66
378	June 5	λ Virginis	D	Merz	W. M.	17 30 58·45	11 19 30·04
	1866.						
379	May 11	ζ Piscium	D B	Merz	G. M.	21 10 26·28	16 37 37·12
380	May 11	B.A.C. 369	D B	Merz	G. M.	21 11 11·40	16 38 22·12
381	May 20	*o* Leonis	D D	Merz	G. M.	14 20 17·72	9 13 12·58
382	May 20	*o* Leonis	R B	Merz	G. M.	14 31 21·73	9 24 14·78
383	June 25	B.A.C. 5579	D D	Merz	G. M.	19 5 57·66	11 36 32·94
384	July 8	δ^3 Tauri	R D	Merz	G. M.	1 28 12·83	17 6 38·64
385	July 8	W.B. IV. 401	D B	Merz	G. M.	1 24 6·66	17 2 33·14
386	July 26	e^2 Sagittarii	D D	Merz	G. M.	14 4 45·59	4 34 16·99
387	July 26	e^2 Sagittarii	R B	Merz	G. M.	15 9 54·02	5 39 14·75
388	Aug. 29	*o* Piscium	D B	Merz	G. M.	20 42 43·27	8 57 28·60
389	Aug. 29	*o* Piscium	R D	Merz	G. M.	21 43 24·69	9 58 0·08
390	Sept. 15	φ Ophiuchi	D D	Merz	G. M.	18 16 14·30	5 24 33·22
391	Sept. 15	φ Ophiuchi	R B	Merz	G. M.	19 3 19·33	6 11 30·54
	1867.						
392	Jan. 9	θ Aquarii	D D	Merz	G. M.	3 3 39·10	6 34 26·20
393	Jan. 29	φ Ophiuchi	R D	Merz	G. M.	10 57 58·85	13 8 51·04
394	April 16	η Virginis	D D	Merz	G. M.	14 41 43·42	11 49 13·14
395	„	„	„	Dollond	J. S.	14 41 41·98	11 49 11·70
396	April 16	η Virginis	R B	Merz	G. M.	15 42 8·29	12 49 28·11
397	Oct. 7	τ^2 Capricorni	D D	Merz	G. M.	21 48 56·68	7 31 8·31
398	„	„	„	Dollond	J. S.	21 48 56·97	7 31 8·60
399	Oct. 7	Lal. 39819	D D	Merz	G. M.	22 12 20·52	7 54 28·31
400	Oct. 7	τ^2 Capricorni	R B	Merz	G. M.	22 45 50·20	8 27 52·51
401	„	„	„	Dollond	J. S.	22 45 43·97	8 27 46·30
402	Dec. 28	τ^2 Capricorni	D D	Merz	G. M.	2 28 28·80	6 47 30·10
403	Dec. 28	Lal. 39819	D D	Merz	G. M.	2 30 57·20	6 49 58·09
	1868.						
404	Feb. 8	ν Leonis	R D	Merz	G. M.	6 11 6·67	7 44 23·26
405	April 4	χ Leonis	D D	Merz	G. M.	9 35 49·59	7 28 21·88
406	Aug. 9	ξ^1 Ceti	D B	Merz	G. M.	3 7 16·70	16 37 36·22
407	Dec. 28	χ^4 Orionis	D B	Merz	G. M.	6 19 39·17	10 35 4·11
408	Dec. 29	ζ Geminorum	D B	Merz	G. M.	4 44 10·33	8 55 55·01

373. Diffused and tremulous.

376, 377. Not good. Cloudy, and the star barely visible.

378. In this occultation the *apparent* path of the star was very nearly that of a tangent to the Moon's south limb. For several minutes the star appeared to skim along the rugged border, and at a distance of about 10″ or 15″ from the detached illuminated mountain tops; at $12^h\ 27^m\ 37^s$ it disappeared (but *not* instantaneously) at an invisible portion of the outline, reappeared at $12^h\ 27^m\ 42^s$, disappeared again at $12^h\ 27^m\ 56^s$, reappeared at $12^h\ 28^m\ 33^s$, disappeared again, and finally reappeared from the illuminated slope of a cavity at about $12^h\ 31^m \pm$. The whole effect of this occultation was very singular and interesting. The star seemed to have lost much of its brilliancy and pungency of light while crossing the valleys and skirting the mountain tops. The time given corresponds to the second disappearance.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
13 26 54·08	− 9 46 15·2	54 8·8	14 45·7	13 25 54·05	− 9 28 17·0
14 12 23·54	−12 51 17·1	54 23·1	14 49·6	14 11 50·94	−12 45 0·8
14 14 24·61	−12 58 45·9	54 23·8	14 49·8	14 11 50·94	−12 45 0·8
15 20 59·90	−16 23 55·5	55 3·9	15 0·7	15 20 42·01	−16 14 41·1
15 23 53·86	−16 31 6·8	55 5·3	15 1·1	15 20 42·01	−16 14 41·1
14 14 29·64	−12 53 44·8	54 41·8	14 54·7	14 11 51·56	−12 45 2·9
1 2 48·59	+ 6 9 13·1	60 37·3	16 31·6	1 6 44·17	+ 6 51 55·6
1 2 50·38	+ 6 9 21·4	60 37·3	16 31·6	1 6 45·55	+ 6 52 8·2
9 37 16·10	+10 11 7·8	56 46·0	15 28·6	9 34 0·85	+10 29 48·4
9 37 39·46	+10 9 32·7	56 45·6	15 28·5	9 34 0·85	+10 29 48·4
16 35 25·27	−17 33 30·4	54 19·2	14 48·5	16 33 52·81	−17 28 45·3
4 16 31·66	+16 57 12·9	60 13·2	16 25·1	4 17 45·35	+17 37 1·3
4 16 21·28	+16 56 53·4	60 13·2	16 25·1	4 19 20·26	+17 54 3·6
19 30 39·38	−16 55 12·9	55 47·6	15 12·6	19 34 54·61	−16 25 49·3
19 33 1·36	−16 50 46·1	55 49·0	15 13·0	19 34 54·61	−16 25 49·3
1 34 17·56	+ 7 45 17·8	59 21·5	16 11·0	1 38 22·36	+ 8 29 9·9
1 36 36·73	+ 7 55 30·5	59 21·9	16 11·1	1 38 22·36	+ 8 29 9·9
16 24 22·75	−16 48 34·4	54 11·8	14 46·5	16 23 30·58	−16 18 59·1
16 25 58·72	−16 51 22·7	54 12·0	14 46·6	16 23 30·58	−16 18 59·1
22 11 47·46	− 8 58 4·5	55 59·3	15 15·8	22 9 47·86	− 8 26 39·8
16 20 54·00	−16 32 48·2	54 6·9	14 45·2	16 23 31·48	−16 19 4·2
12 14 1·43	− 0 30 43·4	56 26·4	15 23·2	12 13 7·96	+ 0 4 10·0
12 14 1·38	− 0 30 43·2	56 26·4	15 23·2	,,	,,
12 16 4·73	− 0 40 54·6	56 25·2	15 22·9	12 13 7·96	+ 0 4 10·0
20 32 2·26	−15 34 56·5	54 36·6	14 53·3	20 31 52·59	−15 24 51·2
20 32 2·27	−15 34 56·5	54 36·6	14 53·3	,,	,,
20 32 50·02	−15 32 53·7	54 37·0	14 53·4	20 32 8·93	−15 26 8·1
20 33 58·39	−15 29 56·7	54 37·5	14 53·5	20 31 52·59	−15 24 51·2
20 33 58·18	−15 29 57·3	54 37·5	14 53·5	,,	,,
20 34 33·55	−16 6 58·9	53 59·0	14 43·0	20 31 51·61	−15 24 54·7
20 34 38·53	−16 6 46·2	53 59·0	14 43·0	20 32 7·95	−15 26 11·6
9 49 14·69	+12 14 48·2	61 3·5	16 38·8	9 51 8·36	+13 4 12·2
10 56 14·72	+ 7 34 18·0	59 35·9	16 14·9	10 58 13·70	+ 8 2 46·2
2 5 50·61	+ 7 36 45·1	55 58·3	15 15·6	2 6 2·15	+ 8 13 40·8
5 56 1·67	+19 35 0·7	59 26·5	16 12·3	5 56 9·01	+20 8 11·6
6 53 18·47	+19 55 1·1	59 57·4	16 20·8	6 56 20·90	+20 45 27·1

381, 383, 384, 385, 386, 387, 389, 390, 391, 393, 394, 396, 397, 399, 402, 403, 404, 405, 406. Good observations.

382. Not so good; Moon's limb boiling.

388. Limb boiling; uncertain to $0^{s}\cdot 5$.

392. A doubt in the count; perhaps the time should be 5^{s} later.

396. Not so good; limb boiling.

400. May have happened a second earlier.

407. The star appeared to enter a hollow and hang upon the edge of it, disappearing gradually; Moon's limb very tremulous.

408. Very bad definition; limb boiling furiously; uncertain to a second or two.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1869.					h m s	h m s
409	March 23	δ Cancri	D D	Merz	G. M.	10 34 28·45	9 14 59·43
410	„	„	„	Dollond	J. S.	10 34 29·25	9 15 0·23
411	March 23	δ Cancri	R B	Merz	G. M.	11 18 13·83	9 58 37·64
412	„	„	„	Dollond	J. S.	11 18 17·93	9 58 41·26
413	May 25	φ Ophiuchi	D B	Merz	G. M.	11 26 0·25	5 58 40·59
414	„	„	„	Dollond	J. S.	11 25 55·25	5 58 35·60
415	Aug. 19	π Capricorni	D D	Merz	G. M.	0 24 45·85	13 17 10·31
416	Aug. 19	ρ Capricorni	D D	Merz	G. M.	1 50 56·45	14 43 6·79
417	Aug. 19	ρ Capricorni	R B	Merz	G. M.	1 59 36·87	14 51 45·79
418	Aug. 29	δ^1 Tauri	D B	Merz	G. M.	2 55 11·13	15 7 51·87
419	„	„	„	Dollond	J. S.	2 55 9·93	15 7 50·67
420	Aug. 29	δ^1 Tauri	R D	Merz	G. M.	4 26 3·21	16 38 29·06
421	„	„	„	Dollond	J. S.	4 26 2·78	16 38 28·63
422	Aug. 29	δ^3 Tauri	D B	Merz	G. M.	5 7 21·87	17 19 40·95
423	Oct. 20	ξ^1 Ceti	D B	Dollond	J. S.	2 25 15·53	11 13 34·04
424	Oct. 20	ξ^1 Ceti	R D	Dollond	J. S.	3 51 35·21	12 39 39·57
	1870.						
425	Feb. 22	B.A.C. 5579	D B	Merz	G. M.	14 55 29·00	15 30 15·85
426	Feb. 22	B.A.C. 5579	R D	Merz	G. M.	15 39 49·07	16 14 28·66
427	„	„	„	Dollond	J. S.	15 39 48·45	16 14 28·04
428	March 10	ζ Tauri	D D	Merz	G. M.	8 14 7·17	7 47 5·26
429	„	„	„	Dollond	J. S.	8 14 7·44	7 47 5·53
430	March 10	ζ Tauri	R B	Dollond	J. S.	9 30 22·61	9 3 8·20
431	March 17	c Virginis	R D	Merz	G. M.	10 18 40·16	9 23 46·50
432	„	„	„	Dollond	J. S.	10 18 45·39	9 23 51·72
433	March 23	μ^1 Sagittarii	D B	Dollond	J. S.	12 55 29·44	11 36 34·65
434	March 23	μ^1 Sagittarii	R D	Dollond	J. S.	13 24 0·14	12 5 0·68
435	March 23	15 Sagittarii	D B	Dollond	J. S.	13 15 32·74	11 56 34·66
436	March 23	15 Sagittarii	R D	Dollond	J. S.	14 7 39·83	12 48 33·21
437	Sept. 7	δ Capricorni	D D	Merz	G. M.	22 27 51·26	10 6 49·92
438	Sept. 7	δ Capricorni	R B	Merz	G. M.	23 45 39·51	11 24 25·42
439	Sept. 28	γ Libræ	D D	Merz	G. M.	19 47 30·58	6 4 21·46
440	Sept. 28	γ Libræ	R B	Merz	G. M.	20 27 59·20	6 44 43·45
441	Oct. 10	ξ^1 Ceti	D B	Dollond	J. S.	22 44 25·92	8 13 36·94
442	Oct. 10	ξ^1 Ceti	R D	Dollond	J. S.	23 54 41·61	9 23 41·12
443	Dec. 27	ψ^1 Aquarii	D D	Merz	G. M.	3 59 3·59	8 20 42·09
444	„	„	„	Dollond	J. S.	3 59 2·85	8 20 41·35
445	Dec. 27	ψ^2 Aquarii	D D	Merz	G. M.	5 8 0·03	9 29 27·24
	1871.						
446	Feb. 1	1 Geminorum	D D	Merz	G. M.	5 9 15·45	7 9 9·65
447	„	„	„	Dollond	J. S.	5 9 14·50	7 9 8·70
448	Feb. 1	1 Geminorum	R B	Merz	G. M.	6 45 40·62	8 45 19·02
449	May 5	θ Libræ	D B	Dollond	C. S.	12 1 3·84	7 54 11·16
450	May 5	θ Libræ	R D	Dollond	C. S.	13 5 1·51	8 57 58·35

409, 411, 415, 416, 417, 418, 419, 425, 426, 428, 433, 437, 438, 439, 443, 445, 446, 450. Good observations.
413. Limb boiling.
416. The star appeared to travel along the limb for at least two minutes without touching, disappearing finally in a hollow.
422. Limb boiling; star exceedingly faint.
428. The outline of the limb visible.
429, 430. Very bad definition.
432. Hazy. Star very faint.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
8 38 1·44	+17 43 3·1	59 50·5	16 18·9	8 37 14·84	+18 37 54·7
8 38 1·47	+17 43 3·0	59 50·5	16 18·9	〃	〃
8 39 50·23	+17 38 39·1	59 51·9	16 19·2	8 37 14·84	+18 37 54·7
16 19 19·86	−16 49 56·5	58 29·8	15 56·9	〃 16 23 40·49	〃 −16 19 27·0
20 21 41·20	−19 2 44·4	55 8·6	15 2·0	〃 20 19 51·77	〃 −18 38 7·5
20 24 46·19	−18 56 25·5	55 7·1	15 1·6	20 21 25·69	−18 14 27·4
20 25 4·79	−18 55 46·7	55 7·0	15 1·6	20 21 25·69	−18 14 27·4
4 13 17·16	+16 27 41·7	55 43·8	15 11·6	4 15 24·40	+17 13 58·7
4 16 29·43	+16 37 59·3	55 46·6	15 12·4	〃 4 15 24·40	〃 +17 13 58·7
4 17 57·06	+16 42 36·7	55 47·8	15 12·7	〃 4 17 56·18	〃 +17 37 33·0
2 5 43·05	+ 7 26 33·6	54 16·7	14 47·9	2 6 6·45	+ 8 14 4·1
2 8 26·34	+ 7 41 4·5	54 17·5	14 48·1	2 6 6·45	+ 8 14 4·1
16 31 44·73	−17 56 21·7	58 22·5	15 54·9	16 34 2·84	−17 29 14·6
16 33 28·74	−18 1 36·2	58 21·3	15 54·6	16 34 2·84	−17 29 14·6
5 30 59·81	+20 26 7·8	55 41·4	15 11·0	〃 5 29 52·28	〃 +21 3 33·4
5 33 47·42	+20 30 57·9	55 43·7	15 11·6	〃	〃
12 13 0·06	+ 3 35 39·1	61 9·5	16 40·4	〃 12 13 45·75	〃 + 4 2 6·5
18 2 20·28	−21 16 14·3	57 54·1	15 47·1	〃 18 5 59·08	〃 −21 5 21·8
18 3 28·71	−21 17 26·1	57 53·1	15 46·9	18 5 59·08	−21 5 21·8
18 3 8·41	−21 17 5·0	57 53·4	15 46·9	18 7 27·31	−20 45 48·6
18 5 13·44	−21 19 12·8	57 51·6	15 46·5	18 7 27·31	−20 45 48·6
21 39 31·10	−17 0 26·1	56 22·5	15 22·2	21 39 54·25	−16 42 44·2
21 42 19·58	−16 49 42·7	56 20·9	15 21·7	21 39 54·25	−16 42 44·2
15 30 28·62	−14 57 55·2	60 19·1	16 26·7	15 28 15·92	−14 21 13·2
15 32 6·49	−15 5 11·1	60 18·3	16 26·4	15 28 15·92	−14 21 13·2
2 3 21·43	+ 7 27 34·7	54 6·4	14 45·1	2 6 9·34	+ 8 14 21·7
2 5 31·84	+ 7 40 18·2	54 5·9	14 44·9	2 6 9·34	+ 8 14 21·7
23 11 19·82	−10 25 36·7	56 21·4	15 21·9	23 9 6·38	− 9 47 34·7
23 13 38·98	−10 12 37·5	56 19·0	15 21·2	〃 23 11 10·40	〃 − 9 53 22·1
5 54 34·07	+22 27 11·4	54 48·5	14 56·5	5 56 16·98	+23 16 2·3
5 58 4·03	+22 31 51·4	54 50·1	14 57·0	〃 5 56 16·98	〃 +23 16 2·3
15 42 22·99	−16 42 10·0	61 11·3	16 40·9	15 46 30·26	−16 20 58·7
15 45 4·01	−16 54 3·7	61 11·3	16 40·9	15 46 30·26	−16 20 58·7

433. This star appeared to hang upon the Moon's limb for two or three seconds before disappearing.
437. The star disappeared suddenly.
439. The star disappeared gradually. The dark limb visible.
440. Very hazy. The limb diffused and tremulous.
443. The star disappeared suddenly; the limb visible.
445. The star appeared to travel along the limb and disappeared suddenly.
448. Limb boiling.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1871.					h m s	h m s
451	June 29	θ Libræ	D D	Merz	C. S.	12 52 50·63	5 9 34·35
452	June 29	θ Libræ	R B	Merz	C. S.	13 54 47·91	6 11 21·48
	1875.						
453	Aug. 10	σ Scorpii	D D	Dollond	W. H. F.	19 4 54·34	8 35 20·63
	1876.						
454	March 5	ι Geminorum	D D	Dollond	W. H. F.	6 49 42·63	6 40 24·13
	1879.						
455	Oct. 31	17 Tauri	D B	Merz	D. G.	23 24 12·21	7 31 23·06
456	„	„	„	Dollond	R. P.	23 23 57·74	7 31 8·63
457	Oct. 31	20 Tauri	D B	Merz	D. G.	23 53 4·00	8 0 10·12
458	„	„	„	Dollond	R. P.	23 52 59·41	8 0 5·54
459	Oct. 31	16 Tauri	R D	Merz	D. G.	0 30 6·74	8 37 6·79
460	Oct. 31	19 Tauri	R D	Merz	W. H. F.	0 51 1·91	8 57 58·53
461	Oct. 31	20 Tauri	R D	Merz	W. H. F.	1 9 46·81	9 16 40·72
462	„	„	„	Dollond	R. P.	1 9 46·50	9 16 40·41
	1880.						
463	Jan. 19	15 Arietis	D D	Merz	W. H. F.	5 50 1·53	8 41 36·24
464	Feb. 5	θ Ophiuchi	D B	Merz	D. G.	12 2 5·45	13 45 48·74
465	„	„	„	Dollond	G. M.	12 2 5·66	13 45 48·95
466	Feb. 5	θ Ophiuchi	R D	Merz	D. G.	13 2 15·58	14 45 49·01
467	Feb. 18	χ^1 Tauri	D D	Merz	W. H. F.	6 4 41·68	6 58 16·70
468	March 3	26 Ophiuchi	R D	Merz	W. H. F.	11 50 24·24	11 47 59·91
469	March 4	7 Sagittarii	R D	Merz	D. G.	12 11 11·68	12 4 48·04
470	March 4	9 Sagittarii	R D	Merz	D. G.	12 36 8·00	12 29 40·28
471	March 4	O Arg. 17540	R D	Merz	D. G.	12 38 5·00	12 31 36·96
472	March 21	d^1 Cancri	D D	Merz	W. H. F.	7 12 32·15	6 0 7·01
473	March 30	B.A.C. 5641	R D	Merz	W. H. F.	17 56 39·37	16 7 5·55
474	April 1	ν^2 Sagittarii	R D	Merz	W. H. F.	16 38 32·24	14 41 19·39
475	April 2	f Sagittarii	R D	Merz	W. H. F.	13 6 52·40	11 6 18·33
476	April 26	19 Scorpii	R D	Merz	W. H. F.	15 54 34·57	12 19 11·24
477	April 27	39 Ophiuchi	R D	Merz	W. H. F.	11 45 5·80	8 6 27·43
478	May 25	4 Sagittarii	D B	Merz	W. H. F.	13 56 8·77	8 27 3·44
479	May 25	4 Sagittarii	R D	Merz	W. H. F.	14 53 58·40	9 24 43·60
480	May 26	o Sagittarii	D B	Merz	G. M.	13 51 25·90	8 18 25·43
481	June 13	B.A.C. 3398	D D	Merz	W. H. F.	11 25 28·46	5 2 2·22
482	June 13	W.B. IX. 1068	D D	Merz	W. H. F.	12 22 54·67	5 39 22·30
483	June 13	B.A.C. 3407	D D	Merz	W. H. F.	13 3 24·97	6 19 45·96

451. Disappeared suddenly.
451, 461, 465, 468, 469, 470, 471, 481, 482, 483, 485, 486. Good observations.
453. Instantaneous.
454. Instantaneous.
455 to 462. A very broken night: Clouds drifting continually over the Moon.
457. Lost in fringe.
459. Seen suddenly but probably from cloud.
460. Impossible to say whether a sudden reappearance from cloud or not.
461. Altered 1^m.
464. Entered apparently on limb and then suddenly disappeared.
466, 467 Sudden.
469. Very exact. Star reappeared quite sharply at spot looked for.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
15 42 57·44	−16 43 25·6	60 36·4	16 31·4	15 46 30·62	−16 20 58·7
15 45 30·06	−16 54 47·6	60 37·8	16 31·8	15 46 30·62	−16 20 58·7
16 14 53·03	−25 36 11·5	54 15·6	14 47·6	16 13 37·95	−25 17 42·3
7 16 38·41	+27 20 24·4	59 24·9	16 11·9	7 18 3·07	+28 2 41·1
3 33 57·39	+23 16 10·8	53 57·2	14 42·6	3 37 46·84	+23 44 12·8
3 34 58·13	+23 18 46·4	53 57·2	14 42·6	3 38 43·02	+23 59 36·9
3 36 16·13	+23 22 4·0	53 57·2	14 42·6	3 37 42·08	+23 54 46·2
3 37 0·20	+23 23 54·5	53 57·2	14 42·6	3 38 5·76	+24 5 29·6
3 37 39·73	+23 25 32·9	53 57·2	14 42·6	3 38 43·02	+23 59 36·9
2 6 26·85	+18 5 7·6	54 27·9	14 50·9	2 4 0·01	+18 56 10·7
17 9 54·17	−25 18 32·1	59 35·5	16 14·8	17 14 39·28	−24 52 44·0
17 12 32·90	−25 18 33·7	59 35·7	16 14·8	17 14 39·28	−24 52 44·0
4 15 47·12	+24 32 50·1	54 13·7	14 47·0	4 15 18·80	+25 20 49·1
16 50 8·28	−25 0 52·5	59 13·0	16 8·6	16 52 50·37	−24 48 20·4
17 53 7·16	−24 47 17·9	59 4·8	16 6·4	17 55 31·46	−24 16 48·4
17 54 11·25	−24 46 12·4	59 4·6	16 6·3	17 56 32·50	−24 21 43·5
17 54 16·26	−24 46 7·2	59 4·6	16 6·3	17 56 37·07	−24 18 51·2
8 14 43·00	+18 6 29·4	55 41·6	15 11·0	8 16 32·13	+18 42 51·7
16 46 23·11	−24 43 42·5	59 45·5	16 17·5	16 44 5·25	−24 37 36·9
18 47 10·12	−23 0 47·6	58 59·1	16 4·9	18 47 53·99	−22 49 10·0
19 37 5·21	−20 32 1·3	58 34·2	15 58·1	19 39 23·49	−20 2 51·8
16 14 22·10	−23 59 41·4	60 48·8	15 34·7	16 13 28·54	−23 52 54·2
17 8 18·36	−24 40 0·9	60 35·1	16 31·0	17 10 45·04	−24 9 22·2
17 48 17·70	−24 16 40·5	61 8·6	16 40·2	17 52 32·02	−23 48 13·8
17 50 56·85	−24 14 3·7	61 7·7	16 39·9	17 52 32·02	−23 48 13·8
18 52 51·31	−22 23 32·6	60 39·4	16 32·2	18 57 33·28	−21 54 52·3
9 50 49·47	+ 8 43 0·4	55 33·5	15 8·8	9 50 6·18	+ 9 29 53·1
9 52 1·53	+ 8 35 24·5	55 34·4	15 9·1	9 51 8·02	+ 9 10 29·1
9 53 19·50	+ 8 27 10·0	55 35·4	15 9·3	9 51 48·04	+ 8 52 58·8

472. Uncertainty of 1ˢ in count.
473. Star seemed to reach its full brightness gradually, in 2 or 3 tenths of a second.
477. Double: the fainter star reappeared about 0ˢ·3 earlier. This time is altered 1ˢ for error in count.
478. Star lost sight of suddenly, but did not seem to have quite reached the bright edge.
479. May be ½ sec. wrong, not more. Observer looking rather far from the illuminated part.
480. Fair observation. Limb boiling.
482. Star seemed just within the Moon's disc, when it disappeared suddenly.
483. The dark limb very plain: it seemed flatter at this point than corresponded to the curvature of the adjacent part. The star reappeared suddenly, but seemed to be at some distance from the bright edge.

Digitized by Google

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
	1880.					h m s	h m s
484	June 13	B.A.C. 3407	R B	Merz	W. H. F.	14 13 21·53	7 29 31·06
485	June 13	W.B. IX. 1110	D D	Merz	W. H. F.	14 1 15·33	7 17 26·85
486	June 13	π Leonis	D D	Merz	W. H. F.	14 23 4·16	7 39 12·10
487	June 14	34 Sextantis	D D	Merz	W. H. F.	11 17 30·69	4 30 13·12
488	June 18	B.A.C. 4722	D D	Merz	W. H. F.	16 29 49·29	9 25 56·91
489	June 20	19 Scorpii	D D	Merz	W. H. F.	15 51 11·65	8 39 33·77
490	June 21	39 Ophiuchi	D D	Merz	W. H. F.	11 18 37·71	4 3 48·57
491	June 25	c^1 Capricorni	D B	Merz	W. H. F.	21 41 56·29	14 9 41·38
492	June 25	c^1 Capricorni	R D	Merz	W. H. F.	22 54 2·01	15 21 35·29
493	June 30	4 Arietis	R D	Merz	W. H. F.	22 4 50·62	14 12 52·40
494	July 19	4 Sagittarii	R B	Merz	W. H. F.	15 52 11·39	6 46 31·90
495	July 19	B.A.C. 6161	D D	Merz	W. H. F.	21 9 37·13	12 3 5·64
496	July 20	o Sagittarii	D D	Merz	W. H. F.	14 40 45·00	5 31 21·30
497	July 20	o Sagittarii	R B	Merz	W. H. F.	15 47 49·52	6 38 14·84
498	July 23	44 Aquarii	R D	Merz	W. H. F.	2 11 2·51	16 47 57·99
499	July 27	η Piscium	D B	Merz	W. H. F.	21 58 23·76	12 20 16·99
500	July 27	η Piscium	R D	Merz	W. H. F.	23 14 15·30	13 35 56·10
501	July 30	36 Tauri	R D	Merz	W. H. F.	0 1 14·10	14 10 59·47
502	Aug. 16	28 Sagittarii	D D	Merz	W. H. F.	20 17 6·70	9 20 38·33
503	Aug. 16	30 Sagittarii	D D	Merz	W. H. F.	22 37 38·75	11 40 47·36
504	Aug. 16	31 Sagittarii	D D	Merz	W. H. F.	23 13 44·66	12 16 47·35
505	Oct. 7	δ Scorpii	D D	Merz	W. H. F.	20 23 47·41	6 2 50·76
506	„	„	„	Dollond	R. P.	20 23 46·91	6 2 50·26
507	Oct. 7	δ Scorpii	R B	Merz	W. H. F.	21 4 21·76	6 43 18·46
508	Oct. 10	π Sagittarii	D D	Merz	W. H. F.	21 37 52·07	7 4 55·56
509	„	„	„	Dollond	R. P.	21 37 52·47	7 4 55·96
510	Oct. 10	π Sagittarii	R B	Merz	W. H. F.	22 22 34·11	7 49 30·28
511	Nov. 6	33 Sagittarii	D D	Merz	R. P.	23 56 21·96	7 36 53·24
512	Dec. 12	26 Arietis	D D	Merz	W. H. F.	3 52 32·88	9 10 52·67

487, 488, 489, 490, 491, 492, 493, 494, 495, 496, 497, 500, 501, 502, 303, 504, 505, 508, 510, 512. Good observations.

487. The light seemed to diminish slightly $0^s\cdot1$ before this time, and then went out suddenly.

490. A double star: the brighter observed.

493. Seemed somewhat gradual.

498. Though not looking exactly at the right place, observer believes he caught the re-appearance

499. Not very good. Moon's limb boiling, and star faint: some doubt of 10^s in count.

Digitized by Google

Moon's Tabular Right Ascension.	Moon's Tabular Declination.	Moon's Tabular Hor. Equat. Parallax.	Moon's Tabular Semi-diameter.	Star's Apparent Right Ascension.	Star's Apparent Declination.
h m s	° ′ ″	′ ″	′ ″	h m s	° ′ ″
9 55 34·11	+ 8 12 53·3	55 37·2	15 9·8	9 51 48·04	+ 8 52 58·8
9 55 10·82	+ 8 15 21·8	55 36·9	15 9·7	9 53 8·10	+ 9 0 21·7
9 55 52·79	+ 8 10 54·1	55 37·5	15 9·9	9 53 54·19	+ 8 36 58·1
10 36 8·09	+ 3 45 24·2	56 12·4	15 19·4	10 36 27·74	+ 4 12 20·4
14 9 43·40	−17 58 15·2	59 48·1	16 18·2	14 8 50·87	−17 38 43·8
16 12 6·58	−23 54 47·9	61 4·3	16 39·0	16 13 29·24	−23 52 55·8
17 5 52·39	−24 34 52·4	61 18·4	16 42·8	17 10 46·02	−24 9 22·6
21 37 38·99	−10 4 27·5	59 10·0	16 7·8	21 38 39·84	− 9 37.41·7
21 40 17·60	− 9 48 11·8	59 7·2	16 7·1	21 38 39·84	− 9 37 41·7
1 40 7·20	+15 39 13·8	55 1·5	15 0·1	1 41 42·80	+16 21 38·3
17 51 38·56	−24 12 6·3	60 49·8	16 35·0	17 52 32·65	−23 48 13·6
18 6 1·52	−23 54 29·4	60 52·0	16 35·6	18 4 28·66	−23 43 27·3
18 53 7·76	−22 21 0·7	60 53·6	16 36·1	18 57 34·22	−21 54 50·3
18 56 5·76	−22 13 17·6	60 53·4	16 36·0	18 57 34·22	−21 54 50·3
22 14 12·72	− 6 13 59·6	59 6·0	16 6·7	22 10 54·57	− 5 58 47·2
1 21 44·30	+13 58 49·2	55 47·3	15 12·6	1 25 7·07	+14 43 53·4
1 24 16·92	+14 12 30·1	55 45·0	15 12·0	1 25 7·07	+14 43 58·4
3 54 51·65	+23 23 10·0	54 16·9	14 47·9	3 57 13·95	+23 46 34·1
18 39 33·39	−22 48 54·7	60 5·5	16 23·0	18 39 10·99	−22 30 55·3
18 45 38·44	−22 35 3·1	60 6·2	16 23·2	18 43 42·30	−22 17 48·7
18 47 12·03	−22 31 21·1	60 6·4	16 23·2	18 45 0·50	−22 3 33·8
15 55 50·62	−22 52 34·7	59 29·2	16 13·1	15 53 17·25	−22 16 53·3
15 57 34·58	−22 55 39·9	59 29·4	16 13·1	15 53 17·25	−22 16 53·3
19 3 54·29	−21 21 26·2	59 12·6	16 8·5	19 2 41·50	−21 12 40·3
19 5 44·83	−21 16 18·2	59 12·2	16 8·4	19 2 41·50	−21 12 40·3
18 49 33·51	−21 45 34·6	59 57·6	16 20·8	18 46 53·15	−21 30 13·5
2 24 21·70	+18 28 8·3	55 7·6	15 1·7	2 24 0·03	+19 19 44·4

507. Definition very bad. Star caught sight of in midst of boiling edge.
509. Not good. Instrument very unsteady.
510. Through fog.
511. Very bad definition.

Digitized by Google

EQUATIONS RESULTING FROM COMPARISON OF OBSERVED OCCULTATIONS WITH HANSEN'S TABLES OF THE MOON.

				h m s
Rot^{n} No. 1.	W.B. VIII. 85	1834, March 20	8 5 33·42 G.M.T.	
$+6''\cdot08 = -\cdot878\Delta\alpha$	$-\cdot305\Delta\delta$	$+\cdot865\Delta\alpha'$	$+\cdot303\Delta\delta'$	$-\cdot325\Delta T$
$-\cdot528\Delta l$	$+\cdot006\Delta\phi'$	$-\ 86\cdot3p$	$-964\cdot8s$	
Rot^{p} No. 3.	Lalande 26414	1834, July 14	6 56 18·28 G.M.T.	
$-1''\cdot73 = -\cdot986\Delta\alpha$	$+\cdot004\Delta\delta$	$-\cdot972\Delta\alpha'$	$-\cdot004\Delta\delta'$	$-\cdot341\Delta T$
$-\cdot543\Delta l$	$+\cdot003\Delta\phi'$	$+1001\cdot6p$	$-966\cdot2s$	
Rot^{n} No. 5.	κ Geminorum	1834, Aug. 30	16 23 47·05 G.M.T.	
$-4''\cdot32 = +\cdot913\Delta\alpha$	$+\cdot015\Delta\delta$	$-\cdot904\Delta\alpha'$	$-\cdot012\Delta\delta'$	$+\cdot432\Delta T$
$+\cdot567\Delta l$	$+\cdot007\Delta\phi'$	$+2257\cdot6p$	$-951\cdot5s$	
Rot^{n} No. 6.	W.B. XXIII. 1016	1834, Dec. 8	7 0 9·58 G.M.T.	
$-2''\cdot08 = -\cdot879\Delta\alpha$	$-\cdot466\Delta\delta$	$+\cdot868\Delta\alpha'$	$+\cdot459\Delta\delta'$	$-\cdot341\Delta T$
$-\cdot498\Delta l$	$+\cdot010\Delta\phi'$	$+\ 244\cdot2p$	$-892\cdot3s$	
Rot^{n} No. 7.	W.B. XXIII. 1029	1834, Dec. 8	7 27 47·06 G.M.T.	
$+3''\cdot61 = -\cdot992\Delta\alpha$	$-\cdot051\Delta\delta$	$+\cdot980\Delta\alpha'$	$+\cdot050\Delta\delta'$	$-\cdot294\Delta T$
$-\cdot465\Delta l$	$+\cdot005\Delta\phi'$	$+1285\cdot3p$	$-892\cdot2s$	
Rot^{n} No. 8.	ξ Virginis	1835, Jan. 18	12 4 28·89 G.M.T.	
$-3''\cdot27 = -\cdot925\Delta\alpha$	$-\cdot355\Delta\delta$	$+\cdot915\Delta\alpha'$	$+\cdot350\Delta\delta'$	$-\cdot264\Delta T$
$-\cdot416\Delta l$	$-\cdot001\Delta\phi'$	$-2462\cdot9p$	$-963\cdot0s$	
Rot^{n} No. 9.	ξ Virginis	1835, Jan. 18	12 51 59·37 G.M.T.	
$-0''\cdot45 = +\cdot106\Delta\alpha$	$-\cdot994\Delta\delta$	$-\cdot104\Delta\alpha'$	$+\cdot983\Delta\delta'$	$+\cdot256\Delta T$
$+\cdot292\Delta l$	$+\cdot013\Delta\phi'$	$-2213\cdot3p$	$-963\cdot0s$	
Rot^{n} No. 10.	h^{2} Sagittarii	1835, June 12	11 14 11·38 G.M.T.	
$+1''\cdot66 = -\cdot811\Delta\alpha$	$-\cdot439\Delta\delta$	$+\cdot798\Delta\alpha'$	$+\cdot436\Delta\delta'$	$-\cdot363\Delta T$
$-\cdot557\Delta l$	$+\cdot004\Delta\phi'$	$-1369\cdot9p$	$-974\cdot7s$	
Rot^{n} No. 11.	ϵ Capricorni	1835, June 14	11 34 41·63 G.M.T.	
$+1''\cdot52 = -\cdot888\Delta\alpha$	$+\cdot318\Delta\delta$	$+\cdot881\Delta\alpha'$	$-\cdot309\Delta\delta'$	$-\cdot341\Delta T$
$-\cdot460\Delta l$	$-\cdot011\Delta\phi'$	$-1654\cdot0p$	$-945\cdot2s$	
Rot^{n} No. 12.	h^{1} Sagittarii	1835, Aug. 6	5 38 32·70 G.MT	
$-0''\cdot06 = -\cdot586\Delta\alpha$	$-\cdot761\Delta\delta$	$+\cdot577\Delta\alpha'$	$+\cdot756\Delta\delta'$	$-\cdot281\Delta T$
$-\cdot416\Delta l$	$+\cdot007\Delta\phi'$	$-2328\cdot5p$	$-965\cdot7s$	

Digitized by Google

Rot^{n} No. 13. h^2 Sagittarii 1835, Aug. 6 h m s 5 45 58·69 G.M.T.

$-1''\cdot32 = -\cdot891\Delta\alpha - \cdot157\Delta\delta + \cdot882\Delta\alpha' + \cdot162\Delta\delta' - \cdot446\Delta T - \cdot587\Delta l - \cdot005\Delta\phi' - 2455\cdot9p - 965\cdot7s$

Rot^{n} No. 14. h^2 Sagittarii 1835, Aug. 6 6 59 52·65 G.M.T.

$-8''\cdot83 = +\cdot881\Delta\alpha - \cdot218\Delta\delta - \cdot870\Delta\alpha' + \cdot214\Delta\delta' + \cdot399\Delta T + \cdot563\Delta l + \cdot009\Delta\phi' + 1430\cdot2p - 965\cdot4s$

Rot^{n} No. 15. κ Capricorni 1835, Aug. 8 9 39 52·72 G.M.T.

$-1''\cdot80 = -\cdot905\Delta\alpha + \cdot272\Delta\delta + \cdot894\Delta\alpha' - \cdot264\Delta\delta' - \cdot293\Delta T - \cdot472\Delta l - \cdot008\Delta\phi' - 848\cdot1p - 948\cdot0s$

Rot^{n} No. 16. κ Capricorni 1835, Oct. 29 5 42 38·98 G.M.T.

$+5''\cdot12 = -\cdot632\Delta\alpha - \cdot740\Delta\delta + \cdot622\Delta\alpha' + \cdot729\Delta\delta' - \cdot336\Delta T - \cdot476\Delta l + \cdot012\Delta\phi' - 684\cdot8p - 935\cdot7s$

Rot^{n} No. 17. Lalande 26280 1836, Feb. 8 10 53 34·68 G.M.T.

$-0''\cdot11 = +\cdot967\Delta\alpha - \cdot160\Delta\delta - \cdot964\Delta\alpha' + \cdot158\Delta\delta' + \cdot504\Delta T + \cdot556\Delta l + \cdot004\Delta\phi' + 2486\cdot2p - 958\cdot0s$

Rot^{n} No. 18. Lalande 26307 1836, Feb. 8 11 21 7·65 G.M.T.

$+7''\cdot84 = +\cdot609\Delta\alpha - \cdot783\Delta\delta - \cdot608\Delta\alpha' + \cdot776\Delta\delta' + \cdot489\Delta T + \cdot511\Delta l + \cdot017\Delta\phi' + 347\cdot4p - 958\cdot1s$

Rot^{n} No. 19. ϕ Sagittarii 1836, June 28 13 2 4·56 G.M.T.

$-10''\cdot27 = +\cdot423\Delta\alpha + \cdot880\Delta\delta - \cdot420\Delta\alpha' - \cdot864\Delta\delta' + \cdot267\Delta T + \cdot309\Delta l - \cdot018\Delta\phi' - 222\cdot7p - 1003\cdot6s$

Rot^{n} No. 20. ϕ Sagittarii 1836, Aug. 22 6 32 32·96 G.M.T.

$-5''\cdot21 = -\cdot888\Delta\alpha - \cdot052\Delta\delta + \cdot873\Delta\alpha' + \cdot055\Delta\delta' - \cdot392\Delta T - \cdot607\Delta l - \cdot001\Delta\phi' - 602\cdot1p - 982\cdot9s$

Rot^{n} No. 21. ϕ Sagittarii 1836, Aug. 22 7 56 23·55 G.M.T.

$+2''\cdot39 = +\cdot888\Delta\alpha - \cdot027\Delta\delta - \cdot874\Delta\alpha' - .030\Delta\delta' - \cdot393\Delta T - \cdot608\Delta l - \cdot001\Delta\phi' - 525\cdot3p - 983\cdot3s$

Rot^{n} No. 22. Oeltz. Arg. 15613 1836, Sept. 16 8 40 10·24 G.M.T.

$-4''\cdot35 = -\cdot891\Delta\alpha - \cdot236\Delta\delta + \cdot890\Delta\alpha' + \cdot230\Delta\delta' - \cdot500\Delta T - \cdot515\Delta l + \cdot012\Delta\phi' + 2439\cdot9p - 962\cdot9s$

Rot^{n} No. 23. ρ Ophiuchi 1836, Sept. 16 8 45 26·75 G.M.T.

$-1''\cdot32 = -\cdot873\Delta\alpha - \cdot304\Delta\delta + \cdot873\Delta\alpha' + \cdot299\Delta\delta' - \cdot489\Delta T - \cdot494\Delta l + \cdot013\Delta\phi' - 2276\cdot1p - 962\cdot9s$

Digitized by Google

Rot^{n} No. 24.	Oeltz. Arg. 15621			1836, Sept. 16			h m s 8 47 32·75	G.M.T.
$-2''\cdot23 = -\cdot810\Delta\alpha$	$-\cdot468\Delta\delta$	$+\cdot811\Delta\alpha'$	$+\cdot462\Delta\delta'$	$-\cdot445\Delta T$	$-\cdot431\Delta l$	$+\cdot015\Delta\phi'$	$+1807\cdot1p$	$-962\cdot9s$
Rot^{n} No. 25.	ϵ Capricorni			1836, Sept. 21			8 12 51·64	G.M.T.
$-2''\cdot47 = -\cdot935\Delta\alpha$	$-\cdot068\Delta\delta$	$+\cdot921\Delta\alpha'$	$+\cdot068\Delta\delta'$	$-\cdot360\Delta T$	$-\cdot575\Delta l$	$+\cdot001\Delta\phi'$	$-35\cdot1p$	$-971\cdot1s$
Rot^{n} No. 26.	ϵ Capricorni			1836, Sept. 21			9 24 57·30	G.M.T.
$-12''\cdot26 = +\cdot525\Delta\alpha$	$+\cdot829\Delta\delta$	$-\cdot519\Delta\alpha'$	$-\cdot814\Delta\delta'$	$+\cdot381\Delta T$	$+\cdot476\Delta l$	$-\cdot015\Delta\phi'$	$+206\cdot5p$	$-970\cdot9s$
Rot^{n} No. 27.	27 Piscium			1836, Oct. 21			8 34 23·70	G.M.T.
$+0''\cdot06 = -\cdot336\Delta\alpha$	$-\cdot942\Delta\delta$	$+\cdot331\Delta\alpha'$	$+\cdot928\Delta\delta'$	$-\cdot341\Delta T$	$-\cdot412\Delta l$	$+\cdot014\Delta\phi'$	$-1596\cdot1p$	$-945\cdot1s$
Rot^{n} No. 28.	29 Piscium			1836, Oct. 21			10 47 57·03	G.M.T.
$+0''\cdot73 = -\cdot714\Delta\alpha$	$-\cdot697\Delta\delta$	$+\cdot706\Delta\alpha'$	$+\cdot689\Delta\delta'$	$-\cdot418\Delta T$	$-\cdot539\Delta l$	$+\cdot014\Delta\phi'$	$-113\cdot0p$	$-944\cdot5s$
Rot^{n} No. 29.	29 Piscium			1836, Oct. 21			12 0 28·12	G.M.T.
$-20''\cdot62 = +\cdot849\Delta\alpha$	$+\cdot525\Delta\delta$	$-\cdot842\Delta\alpha'$	$-\cdot519\Delta\delta'$	$+\cdot455\Delta T$	$+\cdot562\Delta l$	$-\cdot014\Delta\phi'$	$-954\cdot1p$	$-944\cdot1s$
Rot^{n} No. 30.	Oeltz. Arg. 21626			1836, Dec. 12			8 17 1·24	G.M.T.
$+0''\cdot05 = -\cdot641\Delta\alpha$	$-\cdot734\Delta\delta$	$+\cdot643\Delta\alpha'$	$+\cdot727\Delta\delta'$	$-\cdot559\Delta T$	$-\cdot535\Delta l$	$+\cdot017\Delta\phi'$	$+741\cdot7p$	$-977\cdot3s$
Rot^{n} No. 31.	Lalande 14185			1837, May 9			5 22 14·78	G.M.T.
$+2''\cdot77 = -\cdot690\Delta\alpha$	$-\cdot629\Delta\delta$	$+\cdot679\Delta\alpha'$	$+\cdot628\Delta\delta'$	$-\cdot198\Delta T$	$-\cdot355\Delta l$	$+\cdot010\Delta\phi'$	$-320\cdot9p$	$-891\cdot2s$
Rot^{n} No. 32.	δ Scorpii			1837, June 16			6 29 40·74	G.M.T.
$-2''\cdot87 = -\cdot793\Delta\alpha$	$-\cdot514\Delta\delta$	$+\cdot781\Delta\alpha'$	$+\cdot511\Delta\delta'$	$-\cdot222\Delta T$	$-\cdot395\Delta l$	$+\cdot004\Delta\phi'$	$-2000\cdot3p$	$-967\cdot6s$
Rot^{n} No. 33.	Oeltz. Arg. 16481			1837, Aug. 11			8 17 26·59	G.M.T.
$-5''\cdot74 = -\cdot882\Delta\alpha$	$+\cdot146\Delta\delta$	$+\cdot869\Delta\alpha'$	$-\cdot145\Delta\delta'$	$-\cdot390\Delta T$	$-\cdot585\Delta l$	$+\cdot002\Delta\phi'$	$+1405\cdot4p$	$-966\cdot1s$
Rot^{n} No. 34.	23 Tauri			1837, Nov. 12			12 41 1·99	G.M.T.
$-13''\cdot10 = -\cdot743\Delta\alpha$	$-\cdot595\Delta\delta$	$+\cdot731\Delta\alpha'$	$+\cdot591\Delta\delta'$	$-\cdot359\Delta T$	$-\cdot532\Delta l$	$+\cdot009\Delta\phi'$	$-\cdot628\cdot0p$	$-942\cdot3s$

Digitized by Google

Rot^{n} No. 35. 19 Tauri 1838, Aug. 12 h m s 14 47 54·95 G.M.T.

$-1''\cdot42 = +\cdot453\Delta\alpha + \cdot870\Delta\delta - \cdot450\Delta\alpha' - \cdot863\Delta\delta' + \cdot359\Delta T + \cdot408\Delta l - \cdot006\Delta\phi' + 3159\cdot7p - 948\cdot2s$

Rot^{n} No. 36. ϵ Arietis 1838, Oct. 5 12 47 34·55 G.M.T.

$-8''\cdot63 = +\cdot488\Delta\alpha + \cdot855\Delta\delta - \cdot479\Delta\alpha' - \cdot846\Delta\delta' + \cdot366\Delta T + \cdot483\Delta l - \cdot009\Delta\phi' - 2457\cdot1p - 985\cdot9s$

Rot^{n} No. 37. ϵ Arietis 1838, Nov. 29 9 43 9·19 G.M.T.

$+0''\cdot45 = -\cdot874\Delta\alpha + \cdot369\Delta\delta + \cdot861\Delta\alpha' - \cdot366\Delta\delta' - \cdot256\Delta T - \cdot452\Delta l - \cdot002\Delta\phi' + 1562\cdot5p - 983\cdot0s$

Rot^{n} No. 38. δ Capricorni 1839, May 6 13 15 34·69 G.M.T.

$+2''\cdot49 = +\cdot949\Delta\alpha + \cdot112\Delta\delta - \cdot942\Delta\alpha' - \cdot114\Delta\delta' + \cdot441\Delta T + \cdot541\Delta l + \cdot007\Delta\phi' + 2727\cdot6p - 948\cdot9s$

Rot^{n} No. 39. α Virginis 1839, May 24 4 2 2·61 G.M.T.

$-0''\cdot88 = +\cdot397\Delta\alpha + \cdot915\Delta\delta - \cdot392\Delta\alpha' - \cdot908\Delta\delta' - \cdot091\Delta T - \cdot024\Delta l - \cdot010\Delta\phi' + 2314\cdot6p - 884\cdot1s$

Rot^{n} No. 40. α Virginis 1839, May 24 4 18 3·19 G.M.T.

$+1''\cdot46 = +\cdot754\Delta\alpha + \cdot642\Delta\delta - \cdot747\Delta\alpha' - \cdot637\Delta\delta' + \cdot091\Delta T + \cdot197\Delta l - \cdot004\Delta\phi' + 2639\cdot2p - 884\cdot1s$

Rot^{n} No. 41. σ Aquarii 1839, June 3 16 43 4·68 G.M.T.

$-2''\cdot79 = -\cdot927\Delta\alpha - \cdot321\Delta\delta + \cdot914\Delta\alpha' + \cdot317\Delta\delta' - \cdot365\Delta T - \cdot562\Delta l + \cdot006\Delta\phi' - 155\cdot0p - 950\cdot2s$

Rot^{n} No. 42. α Scorpii 1839, June 24 6 49 34·61 G.M.T.

$-2''\cdot14 = -\cdot856\Delta\alpha - \cdot298\Delta\delta + \cdot844\Delta\alpha' + \cdot299\Delta\delta' - \cdot273\Delta T - \cdot448\Delta l + \cdot000\Delta\phi' - 1559\cdot8p - 897\cdot3s$

Rot^{n} No. 43 A^{1} Scorpii 1839, Aug. 17 8 58 55·24 G.M.T.

$-1''\cdot67 = -\cdot840\Delta\alpha + \cdot375\Delta\delta + \cdot832\Delta\alpha' - \cdot375\Delta\delta' - \cdot380\Delta T - \cdot493\Delta l + \cdot002\Delta\phi' + 2659\cdot6p - 891\cdot4s$

Rot^{n} No. 44. A^{2} Scorpii 1839, Aug. 17 9 31 9·14 G.M.T.

$-3''\cdot41 = -\cdot905\Delta\alpha - \cdot043\Delta\delta + \cdot900\Delta\alpha' + \cdot039\Delta\delta' - \cdot415\Delta T - \cdot478\Delta l + \cdot009\Delta\phi' + 2508\cdot8p - 891\cdot5s$

Rot^{n} No. 45. γ Cancri 1840, Feb. 15 10 33 2·60 G.M.T.

$+1''\cdot42 = +\cdot038\Delta\alpha + \cdot999\Delta\delta - \cdot037\Delta\alpha' - \cdot990\Delta\delta' - \cdot192\Delta T - \cdot166\Delta l - \cdot010\Delta\phi' + 2841\cdot1p - 956\cdot7s$

Digitized by Google

Rot^{n} No. 47.			γ Cancri			1840, Feb. 15		h m s 11 13 0·92	G.M.T.
$-10''\cdot26 = +\cdot833\Delta\alpha$	$+\cdot448\Delta\delta$	$-\cdot820\Delta\alpha'$	$-\cdot448\Delta\delta'$	$+\cdot216\Delta T$	$+\cdot404\Delta l$	$-\cdot008\Delta\phi'$	$+241\cdot6p$	$-956\cdot5s$	
Rot^{n} No. 48.			3 Sagittarii			1840, Feb. 26		11 13 26·10	G.M.T.
$-6''\cdot40 = -\cdot828\Delta\alpha$	$-\cdot337\Delta\delta$	$+\cdot829\Delta\alpha'$	$+\cdot345\Delta\delta'$	$-\cdot473\Delta T$	$-\cdot467\Delta l$	$-\cdot004\Delta\phi'$	$-3142\cdot9p$	$-892\cdot6s$	
Rot^{n} No. 49			α Scorpii			1840, March 23		8 14 1·87	G.M.T.
$-2''\cdot41 = -\cdot894\Delta\alpha$	$+\cdot031\Delta\delta$	$+\cdot897\Delta\alpha'$	$-\cdot022\Delta\delta'$	$-\cdot527\Delta T$	$-\cdot487\Delta l$	$-\cdot009\Delta\phi'$	$-2601\cdot0p$	$-885\cdot9s$	
Rot^{n} No. 50			α Scorpii			1840, March 23		9 7 12·59	G.M.T.
$+1''\cdot47 = +\cdot722\Delta\alpha$	$-\cdot589\Delta\delta$	$-\cdot725\Delta\alpha'$	$+\cdot583\Delta\delta'$	$+\cdot488\Delta T$	$+\cdot442\Delta l$	$+\cdot014\Delta\phi'$	$+1260\cdot4p$	$-885\cdot9s$	
Rot^{n} No. 51.			τ Leonis			1840, April 13		7 46 50·07	G.M.T.
$-10''\cdot45 = +\cdot715\Delta\alpha$	$-\cdot698\Delta\delta$	$-\cdot705\Delta\alpha'$	$+\cdot690\Delta\delta'$	$+\cdot365\Delta T$	$+\cdot508\Delta l$	$+\cdot010\Delta\phi'$	$-984\cdot2p$	$-915\cdot4s$	
Rot^{n} No. 52.			ρ Leonis			1840, May 9		9 17 3·53	G.M.T.
$+0''\cdot25 = -\cdot718\Delta\alpha$	$+\cdot686\Delta\delta$	$+\cdot712\Delta\alpha'$	$-\cdot680\Delta\delta'$	$-\cdot439\Delta T$	$-\cdot518\Delta l$	$-\cdot003\Delta\phi'$	$+3057\cdot8p$	$-928\cdot3s$	
Rot^{n} No. 54.			3 Sagittarii			1840, May 18		9 15 55·78	G.M.T.
$-7''\cdot66 = -\cdot881\Delta\alpha$	$+\cdot079\Delta\delta$	$+\cdot873\Delta\alpha'$	$-\cdot071\Delta\delta'$	$-\cdot372\Delta T$	$-\cdot493\Delta l$	$-\cdot008\Delta\phi'$	$-2009\cdot5p$	$-883\cdot6s$	
Rot^{n} No. 55.			3 Sagittarii			1840, May 18		10 40 12·03	G.M.T.
$+2''\cdot35 = +\cdot849\Delta\alpha$	$-\cdot276\Delta\delta$	$-\cdot839\Delta\alpha'$	$+\cdot271\Delta\delta'$	$+\cdot322\Delta T$	$+\cdot475\Delta l$	$+\cdot008\Delta\phi'$	$+1125\cdot1p$	$-883\cdot9s$	
Rot^{n} No. 56.			ϕ Sagittarii			1840, May 19		11 52 47·97	G.M.T.
$-4''\cdot95 = -\cdot872\Delta\alpha$	$-\cdot194\Delta\delta$	$+\cdot859\Delta\alpha'$	$+\cdot196\Delta\delta'$	$-\cdot311\Delta T$	$-\cdot494\Delta l$	$-\cdot001\Delta\phi'$	$-1196\cdot2p$	$-886\cdot8s$	
Rot^{n} No. 57.			ϕ Sagittarii			1840, May 19		13 29 41·68	G.M.T.
$+5''\cdot31 = +\cdot888\Delta\alpha$	$+\cdot045\Delta\delta$	$-\cdot875\Delta\alpha'$	$-\cdot042\Delta\delta'$	$+\cdot296\Delta T$	$+\cdot493\Delta l$	$-\cdot001\Delta\phi'$	$+27\cdot7p$	$-887\cdot1s$	
Rot^{n} No. 58.			h^{2} Sagittarii			1840, May 20		10 37 13·60	G.M.T.
$-6''\cdot56 = -\cdot884\Delta\alpha$	$-\cdot201\Delta\delta$	$+\cdot875\Delta\alpha'$	$+\cdot206\Delta\delta'$	$-\cdot375\Delta T$	$-\cdot500\Delta l$	$-\cdot004\Delta\phi'$	$-2389\cdot2p$	$-891\cdot4s$	

Digitized by Google

Rot^{n} No. 59.	h^2 Sagittarii	1840, May 20	h m s 12 1 46·02 G.M.T.	
$-2''\cdot78 = +\cdot902\Delta\alpha$	$+\cdot055\Delta\delta$	$-\cdot891\Delta\alpha'$	$-\cdot056\Delta\delta'$	$+\cdot328\Delta T$
$+\cdot495\Delta l$	$+\cdot004\Delta\phi'$	$+1560\cdot2p$	$-891\cdot7s$	
Rot^{n} No. 60.	ι Capricorni	1840, May 22	13 59 15·80 G.M.T.	
$-4''\cdot01 = -\cdot946\Delta\alpha$	$-\cdot112\Delta\delta$	$+\cdot934\Delta\alpha'$	$+\cdot114\Delta\delta'$	$-\cdot322\Delta T$
$-\cdot500\Delta l$	$-\cdot003\Delta\phi'$	$-1465\cdot6p$	$-908\cdot8s$	
Rot^{n} No. 61.	ι Capricorni	1840, May 22	15 20 35·20 G.M.T.	
$+3''\cdot84 = +\cdot537\Delta\alpha$	$+\cdot826\Delta\delta$	$-\cdot529\Delta\alpha'$	$-\cdot813\Delta\delta'$	$+\cdot313\Delta T$
$+\cdot433\Delta l$	$-\cdot012\Delta\phi'$	$+1020\cdot1p$	$-909\cdot4s$	
Rot^{n} No. 62.	A^1 Scorpii	1840, June 12	14 18 6·27 G.M.T.	
$-1''\cdot52 = -\cdot683\Delta\alpha$	$+\cdot657\Delta\delta$	$+\cdot678\Delta\alpha'$	$-\cdot656\Delta\delta'$	$-\cdot352\Delta T$
$-\cdot433\Delta l$	$-\cdot002\Delta\phi'$	$+2907\cdot3p$	$-883\cdot1s$	
Rot^{n} No. 64.	α Scorpii	1841, June 30	10 51 47·20 G.M.T.	
$-1''\cdot07 = -\cdot798\Delta\alpha$	$+\cdot459\Delta\delta$	$+\cdot787\Delta\alpha'$	$-\cdot454\Delta\delta'$	$-\cdot308\Delta T$
$-\cdot475\Delta l$	$-\cdot003\Delta\phi'$	$+1590\cdot4p$	$-894\cdot2s$	
Rot^{n} No. 66.	η Piscium	1843, Sept. 11	12 44 17·91 G.M.T.	
$+5''\cdot40 = +\cdot124\Delta\alpha$	$-\cdot992\Delta\delta$	$-\cdot122\Delta\alpha'$	$+\cdot982\Delta\delta'$	$-\cdot131\Delta T$
$-\cdot106\Delta l$	$+\cdot010\Delta\phi'$	$-2392\cdot3p$	$-883\cdot8$	
Rot^{n} No. 67.	π Leonis	1844, Jan. 8	9 43 32·66 G.M.T.	
$-1''\cdot87 = -\cdot908\Delta\alpha$	$+\cdot398\Delta\delta$	$+\cdot900\Delta\alpha'$	$-\cdot397\Delta\delta'$	$-\cdot446\Delta T$
$-\cdot563\Delta l$	$-\cdot012\Delta\phi'$	$-1330\cdot0p$	$-945\cdot0s$	
Rot^{n} No. 68.	π Leonis	1844, Jan. 8	10 57 54·35 G.M.T.	
$+0''\cdot55 = +\cdot865\Delta\alpha$	$-\cdot486\Delta\delta$	$-\cdot855\Delta\alpha'$	$+\cdot482\Delta\delta'$	$+\cdot405\Delta T$
$+\cdot560\Delta l$	$+\cdot011\Delta\phi'$	$+432\cdot5p$	$-945\cdot4s$	
Rot^{n} No. 69.	2 Geminorum	1844, Jan. 31	9 41 1·45 G.M.T.	
$-4''\cdot11 = -\cdot854\Delta\alpha$	$-\cdot376\Delta\delta$	$+\cdot842\Delta\alpha'$	$+\cdot374\Delta\delta'$	$-\cdot284\Delta T$
$-\cdot466\Delta l$	$+\cdot007\Delta\phi'$	$+48\cdot8p$	$-910\cdot7s$	
Rot^{n} No. 70.	Oeltz. Arg. 15890	1844, May 31	10 1 49·09 G.M.T.	
$-1''\cdot07 = -\cdot844\Delta\alpha$	$+\cdot408\Delta\delta$	$+\cdot832\Delta\alpha'$	$-\cdot399\Delta\delta'$	$-\cdot397\Delta T$
$-\cdot591\Delta l$	$-\cdot009\Delta\phi'$	$-194\cdot7p$	$-1001\cdot4s$	
Rot^{n} No. 71.	Oeltz. Arg. 15930	1844, May 31	11 19 51·63 G.M.T.	
$-2''\cdot28 = -\cdot707\Delta\alpha$	$+\cdot645\Delta\delta$	$+\cdot695\Delta\alpha'$	$-\cdot633\Delta\delta'$	$-\cdot326\Delta T$
$-\cdot502\Delta l$	$-\cdot010\Delta\phi'$	$-829\cdot2p$	$-1001\cdot2s$	

Digitized by Google

Rot^{n} No. 72.	B.A.C. 4700			1844, June 25			h m s 10 30 19·52	G.M.T.
$-1''\cdot79 = -\cdot583\Delta\alpha$	$-\cdot795\Delta\delta$	$+\cdot581\Delta\alpha'$	$+\cdot785\Delta\delta'$	$-\cdot195\Delta T$	$-\cdot223\Delta l$	$+\cdot017\Delta\phi'$	$+366\cdot6p$	$-979\cdot8s$
Rot^{n} No. 73.	B.A.C. 4700			1844, June 25			10 57 57·98	G.M.T.
$-1''\cdot00 = +\cdot204\Delta\alpha$	$-\cdot977\Delta\delta$	$-\cdot199\Delta\alpha'$	$+\cdot790\Delta\delta'$	$+\cdot212\Delta T$	$+\cdot282\Delta l$	$+\cdot013\Delta\phi'$	$-2137\cdot9p$	$-979\cdot9s$
Rot^{n} No. 74.	Oeltz. Arg. 15265			1846, July 5			9 18 34·82	G.M.T.
$-1''\cdot97 = -\cdot796\Delta\alpha$	$-\cdot545\Delta\delta$	$+\cdot786\Delta\alpha'$	$+\cdot536\Delta\delta'$	$-\cdot293\Delta T$	$-\cdot445\Delta l$	$+\cdot012\Delta\phi'$	$+349\cdot1p$	$-959\cdot9s$
Rot^{n} No. 75.	α Leonis			1847, April 25			7 50 50·13	G.M.T.
$-1''\cdot04 = -\cdot997\Delta\alpha$	$-\cdot028\Delta\delta$	$+\cdot984\Delta\alpha'$	$+\cdot028\Delta\delta'$	$-\cdot268\Delta T$	$-\cdot463\Delta l$	$+\cdot001\Delta\phi'$	$+235\cdot4p$	$-884\cdot8s$
Rot^{n} No. 76.	o Leonis			1847, June 17			7 2 50·24	G.M.T.
$+0''\cdot09 = -\cdot924\Delta\alpha$	$+\cdot345\Delta\delta$	$+\cdot920\Delta\alpha'$	$-\cdot342\Delta\delta'$	$-\cdot443\Delta T$	$-\cdot506\Delta l$	$+\cdot003\Delta\phi'$	$+3039\cdot8p$	$-898\cdot5s$
Rot^{n} No. 77.	ν Aquarii			1847, Oct. 18			8 51 46·12	G.M.T.
$-3''\cdot05 = -\cdot964\Delta\alpha$	$+\cdot162\Delta\delta$	$+\cdot954\Delta\alpha'$	$-\cdot161\Delta\delta'$	$-\cdot375\Delta T$	$-\cdot534\Delta l$	$+\cdot004\Delta\phi'$	$+2201\cdot0p$	$-961\cdot7s$
Rot^{n} No. 78.	c^{2} Sagittarii			1848, March 28			16 12 6·59	G.M.T.
$-4''\cdot82 = -\cdot952\Delta\alpha$	$-\cdot105\Delta\delta$	$+\cdot939\Delta\alpha'$	$+\cdot106\Delta\delta'$	$-\cdot353\Delta T$	$-\cdot542\Delta l$	$-\cdot002\Delta\phi'$	$-1320\cdot4p$	$-930\cdot3s$
Rot^{n} No. 79.	B.A.C. 4019			1848, April 15			9 0 12·91	G.M.T.
$+0''\cdot87 = -\cdot289\Delta\alpha$	$+\cdot957\Delta\delta$	$+\cdot285\Delta\alpha'$	$-\cdot945\Delta\delta'$	$-\cdot229\Delta T$	$-\cdot286\Delta l$	$-\cdot012\Delta\phi'$	$+1809\cdot8p$	$-889\cdot1s$
Rot^{n} No. 80.	B.A.C. 4019			1848, April 15			10 7 40·81	G.M.T.
$-13''\cdot71 = +\cdot970\Delta\alpha$	$+\cdot244\Delta\delta$	$-\cdot958\Delta\alpha'$	$-\cdot241\Delta\delta'$	$+\cdot240\Delta T$	$+\cdot422\Delta l$	$-\cdot006\Delta\phi'$	$-357\cdot6p$	$-888\cdot9s$
Rot^{n} No. 81.	Lal. 16224			1848, May 8			5 11 25·54	G.M.T.
$-0''\cdot12 = -\cdot661\Delta\alpha$	$+\cdot728\Delta\delta$	$+\cdot653\Delta\alpha'$	$-\cdot720\Delta\delta'$	$-\cdot324\Delta T$	$-\cdot442\Delta l$	$-\cdot006\Delta\phi'$	$+2562\cdot8p$	$-939\cdot0s$
Rot^{n} No. 82.	γ^{1} Libræ			1848, May 17			9 2 49·06	G.M.T.
$-0''\cdot02 = -\cdot848\Delta\alpha$	$+\cdot483\Delta\delta$	$+\cdot838\Delta\alpha'$	$-\cdot474\Delta\delta'$	$-\cdot324\Delta T$	$-\cdot474\Delta l$	$-\cdot001\Delta\phi'$	$-339\cdot1p$	$-886\cdot0s$

Digitized by Google

Rot^{n} No. 84.		γ^{1} Libræ			1848, May 17		h m s 10 35 4·00 G.M.T.		
$+15''\cdot55 = +\cdot951\Delta\alpha$	$-\cdot185\Delta\delta$	$-\cdot938\Delta\alpha'$	$+\cdot183\Delta\delta'$	$+\cdot304\Delta T$	$+\cdot497\Delta l$	$+\cdot003\Delta\phi'$	$-257\cdot6p$	$-886\cdot2s$	
Rot^{n} No. 85.		τ Leonis			1848, June 8		9 24 15·64 G.M.T.		
$-0''\cdot43 = -\cdot454\Delta\alpha$	$+\cdot891\Delta\delta$	$+\cdot452\Delta\alpha'$	$-\cdot886\Delta\delta'$	$-\cdot335\Delta T$	$-\cdot361\Delta l$	$-\cdot008\Delta\phi'$	$+2837\cdot6p$	$-901\cdot0s$	
Rot^{n} No. 87.		e Piscium			1848, Nov. 8		8 27 51·61 G.M.T.		
$-2''\cdot03 = -\cdot679\Delta\alpha$	$-\cdot733\Delta\delta$	$+\cdot669\Delta\alpha'$	$+\cdot722\Delta\delta'$	$-\cdot390\Delta T$	$-\cdot540\Delta l$	$+\cdot010\Delta\phi'$	$-1713\cdot2p$	$-990\cdot9s$	
Rot^{n} No. 88.		δ^{1} Tauri			1848, Nov. 11		14 53 45·89 G.M.T.		
$-11''\cdot29 = -\cdot800\Delta\alpha$	$-\cdot553\Delta\delta$	$+\cdot790\Delta\alpha'$	$+\cdot551\Delta\delta'$	$-\cdot427\Delta T$	$-\cdot576\Delta l$	$+\cdot013\Delta\phi'$	$+535\cdot2p$	$-1003\cdot6s$	
Rot^{n} No. 90.		ξ^{2} Libræ			1849, Feb. 13		11 26 45·07 G.M.T.		
$-13''\cdot26 = -\cdot940\Delta\alpha$	$+\cdot286\Delta\delta$	$+\cdot936\Delta\alpha'$	$-\cdot281\Delta\delta'$	$-\cdot436\Delta T$	$-\cdot498\Delta l$	$-\cdot012\Delta\phi'$	$-1967\cdot2p$	$-891\cdot9s$	
Rot^{n} No. 91.		ξ^{2} Libræ			1849, Feb. 13		12 38 58·62 G.M.T.		
$+1''\cdot45 = +\cdot859\Delta\alpha$	$-\cdot482\Delta\delta$	$-\cdot853\Delta\alpha'$	$+\cdot476\Delta\delta'$	$+\cdot385\Delta T$	$+\cdot483\Delta l$	$+\cdot013\Delta\phi'$	$+1124\cdot8p$	$-891\cdot4s$	
Rot^{n} No. 93.		γ Virginis (North *)			1849, April 6		8 39 25·49 G.M.T.		
$+3''\cdot76 = -\cdot807\Delta\alpha$	$+\cdot590\Delta\delta$	$+\cdot797\Delta\alpha'$	$-\cdot583\Delta\delta'$	$-\cdot353\Delta T$	$-\cdot501\Delta l$	$-\cdot011\Delta\phi'$	$+126\cdot2p$	$-911\cdot3s$	
Rot^{n} No. 95.		γ Virginis (South *)			1849, April 6		8 39 26·79 G.M.T.		
$-0''\cdot67 = -\cdot807\Delta\alpha$	$+\cdot590\Delta\delta$	$+\cdot797\Delta\alpha'$	$-\cdot583\Delta\delta'$	$-\cdot353\Delta T$	$-\cdot501\Delta l$	$-\cdot011\Delta\phi'$	$+126\cdot2p$	$-911\cdot3s$	
Rot^{n} No. 97.		γ Virginis (North *)			1849, April 6		10 6 43·23 G.M.T.		
$-8''\cdot50 = +\cdot928\Delta\alpha$	$-\cdot373\Delta\delta$	$-\cdot915\Delta\alpha'$	$+\cdot368\Delta\delta'$	$+\cdot337\Delta T$	$+\cdot524\Delta l$	$+\cdot006\Delta\phi'$	$-533\cdot3p$	$-910\cdot8s$	
Rot^{n} No. 98.		γ Virginis (South *)			1849, April 6		10 6 46·22 G.M.T.		
$-5''\cdot38 = +\cdot928\Delta\alpha$	$-\cdot373\Delta\delta$	$-\cdot915\Delta\alpha'$	$+\cdot368\Delta\delta'$	$+\cdot337\Delta T$	$+\cdot524\Delta l$	$+\cdot006\Delta\phi'$	$-533\cdot3p$	$-910\cdot8s$	
Rot^{n} No. 100.		ξ^{1} Ceti			1849, July 13		12 54 24·76 G.M.T.		
$-5''\cdot24 = -\cdot771\Delta\alpha$	$+\cdot628\Delta\delta$	$+\cdot766\Delta\alpha'$	$-\cdot627\Delta\delta'$	$-\cdot240\Delta T$	$-\cdot322\Delta l$	$-\cdot015\Delta\phi'$	$-777\cdot7p$	$-960\cdot4s$	

Digitized by Google

Rot^{n} No. 101.	ξ^{1} Ceti			1849, July 13			h m s 13 23 56·10	G.M.T.
$+1''\cdot56 = +\cdot068\Delta\alpha$	$+\cdot998\Delta\delta$	$-\cdot070\Delta\alpha'$	$-\cdot992\Delta\delta'$	$+\cdot228\Delta T$	$+\cdot210\Delta l$	$-\cdot013\Delta\phi'$	$+2314\cdot8p$	$-960\cdot6s$
Rot^{n} No. 103.	ρ^{1} Sagittarii			1849, Sept. 25			8 23 49·20	G.M.T.
$-0''\cdot87 = -\cdot568\Delta\alpha$	$-\cdot801\Delta\delta$	$+\cdot564\Delta\alpha'$	$+\cdot790\Delta\delta'$	$-\cdot264\Delta T$	$-\cdot323\Delta l$	$+\cdot015\Delta\phi'$	$+196\cdot1p$	$-890\cdot9s$
Rot^{n} No. 106.	ρ^{1} Sagittarii			1849, Sept. 25			9 24 18·36	G.M.T.
$-4''\cdot28 = +\cdot831\Delta\alpha$	$-\cdot481\Delta\delta$	$-\cdot823\Delta\alpha'$	$+\cdot480\Delta\delta'$	$+\cdot297\Delta T$	$+\cdot419\Delta l$	$+\cdot000\Delta\phi'$	$-2571\cdot4p$	$-891\cdot1s$
Rot^{n} No. 107.	ξ^{1} Ceti			1849, Oct. 3			7 57 35·72	G.M.T.
$+1''\cdot45 = +\cdot483\Delta\alpha$	$+\cdot873\Delta\delta$	$-\cdot481\Delta\alpha'$	$-\cdot867\Delta\delta'$	$+\cdot400\Delta T$	$+\cdot428\Delta l$	$-\cdot008\Delta\phi'$	$+3131\cdot9p$	$-965\cdot5s$
Rot^{n} No. 109.	Lal. 41168			1849, Nov. 21			6 53 41·10	G.M.T.
$+0''\cdot57 = -\cdot684\Delta\alpha$	$-\cdot705\Delta\delta$	$+\cdot679\Delta\alpha'$	$+\cdot696\Delta\delta'$	$-\cdot349\Delta T$	$-\cdot422\Delta l$	$+\cdot015\Delta\phi'$	$+490\cdot9p$	$-894\cdot3s$
Rot^{n} No. 110.	λ Aquarii			1849, Nov. 23			7 11 49·56	G.M.T.
$-1''\cdot44 = -\cdot708\Delta\alpha$	$-\cdot697\Delta\delta$	$+\cdot700\Delta\alpha'$	$-\cdot688\Delta\delta'$	$-\cdot349\Delta T$	$-\cdot468\Delta l$	$+\cdot013\Delta\phi'$	$-99\cdot1p$	$-914\cdot6s$
Rot^{n} No. 112.	λ Aquarii			1849, Nov. 23			8 28 26·22	G.M.T.
$-1''\cdot03 = +\cdot973\Delta\alpha$	$+\cdot176\Delta\delta$	$-\cdot964\Delta\alpha'$	$-\cdot172\Delta\delta'$	$+\cdot390\Delta T$	$+\cdot521\Delta l$	$-\cdot009\Delta\phi'$	$+712\cdot0p$	$-915\cdot3s$
Rot^{n} No. 113.	μ Piscium			1849, Nov. 26			11 2 34·24	G.M.T.
$-2''\cdot62 = -\cdot400\Delta\alpha$	$-\cdot916\Delta\delta$	$+\cdot395\Delta\alpha'$	$+\cdot909\Delta\delta'$	$-\cdot324\Delta T$	$-\cdot393\Delta l$	$+\cdot015\Delta\phi'$	$-1061\cdot1p$	$-961\cdot8s$
Rot^{n} No. 116.	ν Geminorum			1849, Dec. 1			8 29 49·23	G.M.T.
$-4''\cdot93 = -\cdot483\Delta\alpha$	$-\cdot859\Delta\delta$	$+\cdot483\Delta\alpha'$	$+\cdot853\Delta\delta'$	$-\cdot330\Delta T$	$-\cdot335\Delta l$	$+\cdot006\Delta\phi'$	$-3446\cdot8p$	$-999\cdot5s$
Rot^{n} No. 117.	ν Geminorum			1849, Dec. 1			9 12 13·36	G.M.T.
$+0''\cdot95 = +\cdot707\Delta\alpha$	$-\cdot663\Delta\delta$	$-\cdot697\Delta\alpha'$	$+\cdot661\Delta\delta'$	$+\cdot315\Delta T$	$+\cdot464\Delta l$	$+\cdot013\Delta\phi'$	$-51\cdot8p$	$-999\cdot4s$
Rot^{n} No. 120.	ϕ Aquarii			1850, Jan. 17			7 55 0·99	G.M.T.
$-2''\cdot77 = -\cdot596\Delta\alpha$	$-\cdot799\Delta\delta$	$+\cdot597\Delta\alpha'$	$+\cdot797\Delta\delta'$	$-\cdot435\Delta T$	$-\cdot422\Delta l$	$+\cdot016\Delta\phi'$	$+210\cdot6p$	$-904\cdot0s$

Digitized by Google

Rot^{n} No. 123. δ^{2} Tauri 1850, Jan. 23 h m s 8 13 39·18 G.M.T.

$-4''\cdot38 = -\cdot304\Delta\alpha \; -\cdot949\Delta\delta \; +\cdot299\Delta\alpha' \; +\cdot939\Delta\delta' \; -\cdot209\Delta T \; -\cdot294\Delta l \; +\cdot012\Delta\phi' \; -2245\cdot1p \; -976\cdot7s$

Rot^{n} No. 124. ν Geminorum 1850, Jan. 25 7 38 4·56 G.M.T.

$-5''\cdot36 = -\cdot862\Delta\alpha \; -\cdot405\Delta\delta \; +\cdot850\Delta\alpha' \; +\cdot399\Delta\delta' \; -\cdot395\Delta T \; -\cdot580\Delta l \; +\cdot002\Delta\phi' \; -1996\cdot5p \; -997\cdot1s$

Rot^{n} No. 126. ν Geminorum 1850, Jan. 25 8 54 30·45 G.M.T.

$+4''\cdot65 = +\cdot907\Delta\alpha \; -\cdot274\Delta\delta \; -\cdot893\Delta\alpha' \; +\cdot269\Delta\delta' \; +\cdot386\Delta T \; +\cdot599\Delta l \; +\cdot003\Delta\phi' \; -901\cdot4p \; -997\cdot4s$

Rot^{n} No. 128. χ^{3} Orionis 1850, Feb. 21 7 25 41·07 G.M.T.

$-3''\cdot29 = -\cdot551\Delta\alpha \; +\cdot812\Delta\delta \; +\cdot544\Delta\alpha' \; -\cdot804\Delta\delta' \; -\cdot210\Delta T \; -\cdot320\Delta l \; -\cdot007\Delta\phi' \; +2696\cdot4p \; -977\cdot0s$

Rot^{n} No. 131. χ^{3} Orionis 1850, Feb. 21 8 12 22·50 G.M.T.

$-0''\cdot41 = +\cdot508\Delta\alpha \; +\cdot843\Delta\delta \; -\cdot499\Delta\alpha' \; -\cdot837\Delta\delta' \; +\cdot220\Delta T \; +\cdot351\Delta l \; -\cdot011\Delta\phi' \; +1701\cdot0p \; -977\cdot3s$

Rot^{n} No. 132. χ^{4} Orionis 1850, Feb. 21 7 41 25·20 G.M.T.

$-5''\cdot44 = -\cdot554\Delta\alpha \; -\cdot810\Delta\delta \; +\cdot545\Delta\alpha' \; +\cdot803\Delta\delta' \; -\cdot242\Delta T \; -\cdot380\Delta l \; +\cdot010\Delta\phi' \; -1817\cdot8p \; -977\cdot1s$

Rot^{n} No. 134. χ^{4} Orionis 1850, Feb. 21 8 30 57·91 G.M.T.

$-0''\cdot85 = +\cdot592\Delta\alpha \; -\cdot779\Delta\delta \; -\cdot586\Delta\alpha' \; +\cdot770\Delta\delta' \; +\cdot258\Delta T \; +\cdot350\Delta l \; +\cdot005\Delta\phi' \; -3055\cdot8p \; -977\cdot4s$

Rot^{n} No. 135. Lal. 12358 1850, April 17 5 14 56·91 G.M.T.

$-2''\cdot26 = -\cdot801\Delta\alpha \; +\cdot525\Delta\delta \; +\cdot792\Delta\alpha' \; -\cdot520\Delta\delta' \; -\cdot352\Delta T \; -\cdot496\Delta l \; -\cdot002\Delta\phi' \; +2613\cdot8p \; -970\cdot0s$

Rot^{n} No. 137. ν Geminorum 1850, April 17 5 19 40·43 G.M.T.

$-1''\cdot80 = -\cdot765\Delta\alpha \; +\cdot583\Delta\delta \; +\cdot756\Delta\alpha' \; -\cdot577\Delta\delta' \; -\cdot340\Delta T \; -\cdot472\Delta l \; -\cdot002\Delta\phi' \; +2758\cdot1p \; -970\cdot0s$

Rot^{n} No. 140. ν Geminorum 1850, April 17 6 25 29·53 G.M.T.

$-0''\cdot44 = +\cdot842\Delta\alpha \; +\cdot448\Delta\delta \; -\cdot831\Delta\alpha' \; -\cdot450\Delta\delta' \; +\cdot374\Delta T \; +\cdot534\Delta l \; -\cdot011\Delta\phi' \; -711\cdot1p \; -970\cdot1s$

Rot^{n} No. 142. B.A.C. 3041 1850, June 13 6 8 57·73 G.M.T.

$-1''\cdot96 = -\cdot557\Delta\alpha \; -\cdot813\Delta\delta \; +\cdot549\Delta\alpha' \; +\cdot812\Delta\delta' \; -\cdot147\Delta T \; -\cdot259\Delta l \; +\cdot015\Delta\phi' \; -416\cdot8p \; -986\cdot6s$

Digitized by Google

Rotn No. 143. Lal. 17633 1850, June 13 6 h 10 m 2·25 s G.M.T.

$-2''\cdot43 = -\cdot868\Delta\alpha + \cdot419\Delta\delta + \cdot863\Delta\alpha' - \cdot415\Delta\delta' - \cdot520\Delta T - \cdot594\Delta l + \cdot003\Delta\phi' + 3360\cdot4p - 986\cdot6s$

Rotn No. 144. ν Piscium 1850, July 30 12 18 9·51 G.M.T.

$-0''\cdot57 = +\cdot772\Delta\alpha + \cdot633\Delta\delta - \cdot766\Delta\alpha' - \cdot628\Delta\delta' + \cdot410\Delta T + \cdot499\Delta l - \cdot003\Delta\phi' + 2978\cdot9p - 919\cdot1s$

Rotn No. 146. χ^4 Orionis 1850, Aug. 31 15 2 50·74 G.M.T.

$+0''\cdot26 = -\cdot581\Delta\alpha + \cdot788\Delta\delta + \cdot572\Delta\alpha' - \cdot786\Delta\delta' - \cdot181\Delta T - \cdot315\Delta l - \cdot013\Delta\phi' + 764\cdot2p - 969\cdot3s$

Rotn No. 147. ζ Geminorum 1850, Sept. 1 15 19 0·15 G.M.T.

$+3''\cdot81 = +\cdot939\Delta\alpha - \cdot023\Delta\delta - \cdot931\Delta\alpha' + \cdot025\Delta\delta' + \cdot476\Delta T + \cdot604\Delta l + \cdot008\Delta\phi' + 2369\cdot6p - 980\cdot4s$

Rotn No. 148. δ Cancri 1850, Sept. 30 14 15 22·01 G.M.T.

$+2''\cdot62 = +\cdot945\Delta\alpha + \cdot108\Delta\delta - \cdot940\Delta\alpha' - \cdot105\Delta\delta' + \cdot502\Delta T + \cdot579\Delta l + \cdot008\Delta\phi' + 2965\cdot4p - 977\cdot8s$

Rotn No. 149. ξ^1 Ceti 1850, Nov. 17 7 11 16·34 G.M.T.

$-0''\cdot46 = +\cdot181\Delta\alpha - \cdot983\Delta\delta - \cdot178\Delta\alpha' + \cdot973\Delta\delta' - \cdot132\Delta T - \cdot085\Delta l + \cdot013\Delta\phi' - 1952\cdot0p - 933\cdot6s$

Rotn No. 150. ξ^1 Ceti 1850, Nov. 17 7 39 57·70 G.M.T.

$-0''\cdot58 = +\cdot779\Delta\alpha - \cdot619\Delta\delta - \cdot769\Delta\alpha' + \cdot612\Delta\delta' + \cdot138\Delta T + \cdot296\Delta l + \cdot010\Delta\phi' - 584\cdot8p - 933\cdot9s$

Rotn No. 151. δ^3 Tauri 1851, March 9 8 27 57·57 G.M.T.

$-4''\cdot14 = -\cdot941\Delta\alpha - \cdot183\Delta\delta + \cdot935\Delta\alpha' + \cdot185\Delta\delta' - \cdot457\Delta T - \cdot542\Delta l + \cdot011\Delta\phi' + 2193\cdot7p - 931\cdot1s$

Rotn No. 154. ν Capricorni 1851, March 26 16 18 2·08 G.M.T.

$-0\cdot65 = -\cdot472\Delta\alpha - \cdot866\Delta\delta + \cdot465\Delta\alpha' + \cdot858\Delta\delta' - \cdot201\Delta T - \cdot311\Delta l + \cdot010\Delta\phi' - 1794\cdot9p - 887\cdot4s$

Rotn No. 155. B.A.C. 5579 1851, April 18 12 58 26·50 G.M.T.

$-1''\cdot66 = -\cdot717\Delta\alpha - \cdot658\Delta\delta + \cdot706\Delta\alpha' + \cdot649\Delta\delta' - \cdot177\Delta T - \cdot338\Delta l + \cdot010\Delta\phi' - 967\cdot6p - 942\cdot2s$

Rotn No. 156. B.A.C. 5579 1851, April 18 13 42 25·83 G.M.T.

$+0''\cdot94 = +\cdot189\Delta\alpha - \cdot980\Delta\delta - \cdot186\Delta\alpha' + \cdot964\Delta\delta' + \cdot173\Delta T + \cdot218\Delta l + \cdot016\Delta\phi' - 973\cdot4p - 941\cdot7s$

Digitized by Google

Rotn No. 157. μ Sagittarii 1851, May 17 h m s 15 20 30·69 G.M.T.

$-0''\cdot19 = -\cdot630\Delta\alpha + \cdot738\Delta\delta + \cdot620\Delta\alpha' - \cdot728\Delta\delta' - \cdot244\Delta T - \cdot389\Delta l - \cdot008\Delta\phi' + 1686\cdot3p - 923\cdot5s$

Rotn No. 159. μ Sagittarii 1851, May 17 16 14 25·91 G.M.T.

$+0''\cdot93 = +\cdot605\Delta\alpha + \cdot761\Delta\delta - \cdot602\Delta\alpha' - \cdot748\Delta\delta' + \cdot269\Delta T + \cdot322\Delta l - \cdot015\Delta\phi' - 525\cdot5p - 923\cdot0s$

Rotn No. 161. ξ^1 Sagittarii 1851, May 18 8 12 22·68 G.M.T.

$-0''\cdot29 = -\cdot582\Delta\alpha - \cdot780\Delta\delta + \cdot578\Delta\alpha' + \cdot780\Delta\delta' - \cdot259\Delta T - \cdot329\Delta l + \cdot005\Delta\phi' - 3014\cdot7p - 915\cdot6s$

Rotn No. 163. ξ^2 Sagittarii 1851, May 18 8 28 34·52 G.M.T.

$+1''\cdot60 = -\cdot376\Delta\alpha + \cdot915\Delta\delta + \cdot380\Delta\alpha' - \cdot907\Delta\delta' - \cdot269\Delta T - \cdot216\Delta l - \cdot016\Delta\phi' + 306\cdot7p - 915\cdot5s$

Rotn No. 166. ξ^2 Sagittarii 1851, May 18 9 2 59·08 G.M.T.

$+1''\cdot69 = +\cdot628\Delta\alpha + \cdot738\Delta\delta - \cdot621\Delta\alpha' - \cdot736\Delta\delta' + \cdot260\Delta T + \cdot354\Delta l - \cdot004\Delta\phi' + 2833\cdot5p - 915\cdot2s$

Rotn No. 169. c Virginis 1851, June 7 10 39 2·08 G.M.T.

$-2''\cdot88 = -\cdot945\Delta\alpha - \cdot321\Delta\delta + \cdot940\Delta\alpha' + \cdot321\Delta\delta' - \cdot377\Delta T - \cdot450\Delta l + \cdot013\Delta\phi' + 1977\cdot4p - 966\cdot8s$

Rotn No. 172. ι Capricorni 1851, June 17 12 11 10·29 G.M.T.

$-0''\cdot49 = -\cdot628\Delta\alpha - \cdot751\Delta\delta + \cdot619\Delta\alpha' + \cdot743\Delta\delta' - \cdot269\Delta T - \cdot404\Delta l + \cdot008\Delta\phi' - 1719\cdot4p - 893\cdot6s$

Rotn No. 173. ι Capricorni 1851, June 17 13 29 28·85 G.M.T.

$-0''\cdot77 = +\cdot909\Delta\alpha - \cdot299\Delta\delta - \cdot897\Delta\alpha' + \cdot295\Delta\delta' + \cdot254\Delta T + \cdot436\Delta l + \cdot006\Delta\phi' + 256\cdot9p - 893\cdot3s$

Rotn No. 175. π Sagittarii 1851, July 12 5 35 45·62 G.M.T.

$-2''\cdot43 = -\cdot911\Delta\alpha + \cdot202\Delta\delta + \cdot908\Delta\alpha' - \cdot192\Delta\delta' - \cdot466\Delta T - \cdot511\Delta l - \cdot011\Delta\phi' - 2313\cdot6p - 909\cdot0s$

Rotn No. 176. ξ^2 Sagittarii 1851, Aug. 8 7 24 45·22 G.M.T.

$-1''\cdot74 = -\cdot860\Delta\alpha - \cdot379\Delta\delta + \cdot848\Delta\alpha' + \cdot376\Delta\delta' - \cdot293\Delta T - \cdot479\Delta l + \cdot004\Delta\phi' - 984\cdot5p - 906\cdot6s$

Rotn No. 178. ξ^2 Sagitarii 1851, Aug. 8 8 51 19·93 G.M.T.

$+2''\cdot35 = +\cdot841\Delta\alpha - \cdot427\Delta\delta - \cdot829\Delta\alpha' + \cdot422\Delta\delta' + \cdot285\Delta T + \cdot468\Delta l + \cdot006\Delta\phi' - 563\cdot3p - 906\cdot2s$

Digitized by Google

Rot^{n} No. 180.		O. Arg. 17592		1851, Oct. 28			h m s 7 5 2·04 G.M.T.	
$+0''.10 = -\cdot795\Delta\alpha$	$-\cdot518\Delta\delta$	$+\cdot794\Delta\alpha'$	$+\cdot512\Delta\delta'$	$-\cdot432\Delta T$	$-\cdot448\Delta l$	$+\cdot015\Delta\phi'$	$+1577\cdot1p$	$-938\cdot9s$
Rot^{n} No. 181.		O. Arg. 17648.		1851, Oct. 28			7 52 4·34 G.M.T.	
$+1''.39 = -\cdot912\Delta\alpha$	$-\cdot189\Delta\delta$	$+\cdot912\Delta\alpha'$	$+\cdot184\Delta\delta'$	$-\cdot522\Delta T$	$-\cdot533\Delta l$	$+\cdot012\Delta\phi'$	$+2482\cdot5p$	$-938\cdot5s$
Rot^{n} No. 182.		B.A.C. 6125.		1851, Oct. 28			7 57 39·22 G.M.T.	
$-0''.15 = -\cdot595\Delta\alpha$	$+\cdot768\Delta\delta$	$+\cdot591\Delta\alpha'$	$-\cdot767\Delta\delta'$	$-\cdot316\Delta T$	$-\cdot387\Delta l$	$-\cdot004\Delta\phi'$	$+3112\cdot1p$	$-938\cdot4s$
Rot^{n} No. 183.		ϵ Tauri		1851, Dec. 7			8 41 28·31 G.M.T.	
$-1''.73 = -\cdot456\Delta\alpha$	$-\cdot878\Delta\delta$	$+\cdot451\Delta\alpha'$	$+\cdot869\Delta\delta'$	$-\cdot290\Delta T$	$-\cdot362\Delta l$	$+\cdot007\Delta\phi'$	$-2767\cdot9p$	$-921\cdot4s$
Rot^{n} No. 185.		ϵ Tauri		1851, Dec. 7			9 51 7·61 G.M.T.	
$-0''.37 = +\cdot926\Delta\alpha$	$-\cdot229\Delta\delta$	$-\cdot912\Delta\alpha'$	$+\cdot226\Delta\delta'$	$+\cdot282\Delta T$	$+\cdot480\Delta l$	$+\cdot003\Delta\phi'$	$-483\cdot9p$	$-921\cdot9s$
Rot^{n} No. 187.		ν Piscium		1851, Dec. 31			7 24 32·89 G.M.T.	
$+2''.01 = -\cdot997\Delta\alpha$	$+\cdot014\Delta\delta$	$+\cdot985\Delta\alpha'$	$-\cdot014\Delta\delta'$	$-\cdot281\Delta T$	$-\cdot459\Delta l$	$+\cdot003\Delta\phi'$	$+1211\cdot0p$	$-891\cdot5s$
Rot^{n} No. 189.		o Sagittarii		1852, Feb. 15			14 44 33·15 G.M.T.	
$+0''.40 = -\cdot831\Delta\alpha$	$-\cdot439\Delta\delta$	$+\cdot826\Delta\alpha'$	$+\cdot443\Delta\delta'$	$-\cdot412\Delta T$	$-\cdot480\Delta l$	$-\cdot002\Delta\phi'$	$-3149\cdot4p$	$-920\cdot6s$
Rot^{n} No. 190.		o Sagittarii		1852, Feb. 15			15 37 41·18 G.M.T.	
$+0''.33 = +\cdot671\Delta\alpha$	$-\cdot688\Delta\delta$	$-\cdot670\Delta\alpha'$	$+\cdot679\Delta\delta'$	$+\cdot372\Delta T$	$+\cdot386\Delta l$	$+\cdot016\Delta\phi'$	$+967\cdot0p$	$-920\cdot3s$
Rot^{n} No. 191.		ξ^{2} Libræ		1852, March 9			11 3z 35·51 G.M.T.	
$-0''.71 = -\cdot965\Delta\alpha$	$-\cdot177\Delta\delta$	$+\cdot954\Delta\alpha'$	$+\cdot178\Delta\delta'$	$-\cdot362\Delta T$	$-\cdot525\Delta l$	$-\cdot004\Delta\phi'$	$-2272\cdot5p$	$-981\cdot8s$
Rot^{n} No. 193.		ξ^{2} Libræ		1852, March 9			12 27 30·17 G.M.T.	
$+1''.29 = +\cdot331\Delta\alpha$	$-\cdot941\Delta\delta$	$-\cdot328\Delta\alpha'$	$+\cdot928\Delta\delta'$	$+\cdot337\Delta T$	$+\cdot383\Delta l$	$+\cdot017\Delta\phi'$	$-892\cdot7p$	$-981\cdot4s$
Rot^{n} No. 195.		Lal. 24306		1852, July 22			7 55 24·61 G.M.T.	
$-2''.14 = -\cdot590\Delta\alpha$	$-\cdot807\Delta\delta$	$+\cdot586\Delta\alpha'$	$+\cdot802\Delta\delta'$	$-\cdot076\Delta T$	$-\cdot132\Delta l$	$+\cdot017\Delta\phi'$	$-31\cdot5p$	$-971\cdot1s$

Digitized by Google

Rot^{n} No. 196. Lal. 27713 1852, Sept. 17 6 19 26·82 G.M.T.

$-3''\cdot84 = -\cdot918\Delta\alpha + \cdot326\Delta\delta + \cdot911\Delta\alpha' - \cdot325\Delta\delta' - \cdot502\Delta T - \cdot609\Delta l + \cdot003\Delta\phi' + 3078\cdot6p - 983\cdot8s$

Rot^{n} No. 197. Lal. 27729 1852, Sept. 17 6 44 41·47 G.M.T.

$-4''\cdot74 = -\cdot619\Delta\alpha + \cdot771\Delta\delta + \cdot613\Delta\alpha' - \cdot767\Delta\delta' - \cdot435\Delta T - \cdot520\Delta l - \cdot006\Delta\phi' + 3105\cdot1p - 983\cdot6s$

Rot^{n} No. 198. Lal. 29395 1852, Sept. 18 5 30 23·77 G.M.T.

$-1''\cdot88 = -\cdot432\Delta\alpha + \cdot891\Delta\delta + \cdot425\Delta\alpha' - \cdot880\Delta\delta' - \cdot287\Delta T - \cdot401\Delta l - \cdot012\Delta\phi' + 1881\cdot2p - 973\cdot9s$

Rot^{n} No. 199. Lal. 33386 1852, Sept. 20 7 40 58·81 G.M.T.

$-1''\cdot53 = -\cdot598\Delta\alpha + \cdot759\Delta\delta + \cdot589\Delta\alpha' - \cdot751\Delta\delta' - \cdot256\Delta T - \cdot399\Delta l - \cdot018\Delta\phi' + 1982\cdot9p - 948\cdot9s$

Rot^{n} No. 200. η Capricorni 1852, Sept. 23 7 46 18·98 G.M.T.

$-1''\cdot00 = -\cdot737\Delta\alpha + \cdot617\Delta\delta + \cdot726\Delta\alpha' - \cdot607\Delta\delta' - \cdot176\Delta T - \cdot338\Delta l - \cdot009\Delta\phi' + 626\cdot5p - 916\cdot6s$

Rot^{n} No. 201. O. Arg. 20874 1852, Oct. 20 6 50 39·03 G.M.T.

$+1''\cdot54 = -\cdot922\Delta\alpha - \cdot138\Delta\delta + \cdot910\Delta\alpha' + \cdot136\Delta\delta' - \cdot347\Delta T - \cdot535\Delta l + \cdot005\Delta\phi' + 859\cdot2p - 924\cdot5s$

Rot^{n} No. 202. O. Arg. 20885 1852, Oct. 20 7 13 0·74 G.M.T.

$-1''\cdot20 = -\cdot931\Delta\alpha - \cdot022\Delta\delta + \cdot919\Delta\alpha' + \cdot021\Delta\delta' - \cdot343\Delta T - \cdot528\Delta l + \cdot004\Delta\phi' + 1207\cdot6p - 924\cdot3s$

Rot^{n} No. 203. O. Arg. 21591 1852, Oct. 21 7 52 25·08 G.M.T.

$+0''\cdot07 = -\cdot914\Delta\alpha - \cdot269\Delta\delta + \cdot902\Delta\alpha' + \cdot265\Delta\delta' - \cdot349\Delta T - \cdot522\Delta l + \cdot008\Delta\phi' + 790\cdot9p - 912\cdot5s$

Rot^{n} No. 204. Lal. 43998 1852, Oct. 22 7 6 32·84 G.M.T.

$+0''\cdot76 = -\cdot701\Delta\alpha - \cdot689\Delta\delta + \cdot691\Delta\alpha' + \cdot679\Delta\delta' - \cdot321\Delta T - \cdot467\Delta l + \cdot010\Delta\phi' - 744\cdot2p - 903\cdot2s$

Rot^{n} No. 205. ψ^{3} Aquarii 1852, Oct. 23 6 27 1·23 G.M.T.

$-2''\cdot94 = -\cdot939\Delta\alpha + \cdot293\Delta\delta + \cdot928\Delta\alpha' - \cdot287\Delta\delta' - \cdot220\Delta T - \cdot396\Delta l - \cdot007\Delta\phi' - 516\cdot6p - 895\cdot7s$

Rot^{n} No. 206. ξ Virginis 1853, April 20 6 51 35·83 G.M.T.

$-2''\cdot20 = -\cdot700\Delta\alpha - \cdot707\Delta\delta + \cdot691\Delta\alpha' + \cdot698\Delta\delta' - \cdot088\Delta T - \cdot217\Delta l + \cdot006\Delta\phi' - 2543\cdot5p - 971\cdot1s$

Digitized by Google

Rot^{n} No. 207. B.A.C. 4599 1853, Sept. 6 5 54 15·94 G.M.T.

$-6''\cdot01 = -\cdot989\Delta\alpha + \cdot097\Delta\delta + \cdot983\Delta\alpha' - \cdot097\Delta\delta' - \cdot475\Delta T - \cdot557\Delta l + \cdot007\Delta\phi' + 2893\cdot6p - 966\cdot4s$

Rot^{n} No. 208. Lal. 28453 1853, Sept. 8 6 45 12·41 G.M.T.

$-2''\cdot57 = -\cdot674\Delta\alpha + \cdot708\Delta\delta + \cdot666\Delta\alpha' - \cdot702\Delta\delta' - \cdot405\Delta T - \cdot530\Delta l - \cdot005\Delta\phi' + 2692\cdot0p - 970\cdot6s$

Rot^{n} No. 209. B.A.C. 6369 1853, Sept. 11 8 38 14·56 G.M.T.

$-2''\cdot16 = -\cdot698\Delta\alpha + \cdot636\Delta\delta + \cdot687\Delta\alpha' - \cdot629\Delta\delta' - \cdot293\Delta T - \cdot457\Delta l - \cdot006\Delta\phi' + 1973\cdot7p - 964\cdot9s$

Rot^{n} No. 210. B.A.C. 7378 1853, Nov. 7 8 54 36·51 G.M.T.

$-4''\cdot29 = -\cdot907\Delta\alpha - \cdot230\Delta\delta + \cdot902\Delta\alpha' + \cdot225\Delta\delta' - \cdot487\Delta T - \cdot568\Delta l + \cdot012\Delta\phi' + 2194\cdot6p - 952\cdot1s$

Rot. No. 211. B.A.C. 81 1853, Dec. 8 8 44 56·44 G.M.T.

$-0''\cdot29 = -\cdot769\Delta\alpha + \cdot637\Delta\delta + \cdot761\Delta\alpha' - \cdot631\Delta\delta' - \cdot103\Delta T - \cdot221\Delta l - \cdot004\Delta\phi' + 2585\cdot3p - 916\cdot1s$

Rot^{n} No. 212. B.A.C. 1896 1854, March 7 7 4 41·29 G.M.T.

$+1''\cdot26 = -\cdot343\Delta\alpha + \cdot925\Delta\delta + \cdot341\Delta\alpha' - \cdot918\Delta\delta' - \cdot103\Delta T - \cdot142\Delta l - \cdot006\Delta\phi' + 2906\cdot0p - 886\cdot9s$

Rot^{n} No. 213. B.A.C. 1896 1854, March 7 7 38 57·14 G.M.T.

$-1''\cdot78 = +\cdot314\Delta\alpha + \cdot938\Delta\delta - \cdot307\Delta\alpha' - \cdot935\Delta\delta' + \cdot114\Delta T + \cdot214\Delta l - \cdot010\Delta\phi' + 1994\cdot4p - 886\cdot9s$

Rot^{n} No. 214. *b* Ophiuchi 1854, March 20 11 18 35·12 G.M.T.

$+3''\cdot41 = +\cdot882\Delta\alpha - \cdot247\Delta\delta - \cdot879\Delta\alpha' + \cdot241\Delta\delta' + \cdot547\Delta T + \cdot587\Delta l + \cdot012\Delta\phi' + 2387\cdot4p - 968\cdot5s$

Rot^{n} No. 215. h^{2} Sagittarii 1854, March 22 12 19 8·22 G.M.T.

$-0''\cdot32 = -8\cdot80\Delta\alpha - \cdot215\Delta\delta + \cdot878\Delta\alpha' + \cdot223\Delta\delta' - \cdot557\Delta T - \cdot584\Delta l - \cdot006\Delta\phi' + 3268\cdot8p - 968\cdot4s$

Rot^{n} No. 216. h^{2} Sagittarii 1854, March 22 13 14 53·52 G.M.T.

$+1''\cdot82 = +\cdot843\Delta\alpha - \cdot353\Delta\delta - \cdot842\Delta\alpha' + \cdot346\Delta\delta' + \cdot508\Delta T + \cdot532\Delta l + \cdot014\Delta\phi' + 2161\cdot7p - 968\cdot4s$

Rot^{n} No. 217. κ Virginis 1854, April 13 9 21 55·16 G.M.T.

$-2''\cdot27 = -\cdot404\Delta\alpha + \cdot912\Delta\delta + \cdot400\Delta\alpha' - \cdot899\Delta\delta' - \cdot384\Delta T - \cdot444\Delta l - \cdot016\Delta\phi' + 766\cdot6p - 966\cdot7s$

Digitized by Google

Rot^{n} No. 218.		κ Virginis		1854, April 13		h m s 10 28 28·57 G.M.T.		
$+3''\cdot23 = +\cdot973\Delta\alpha$	$-\cdot155\Delta\delta$	$-\cdot959\Delta\alpha'$	$+\cdot153\Delta\delta'$	$+\cdot365\Delta T$	$+\cdot569\Delta l$	$+\cdot005\Delta\phi'$	$+471\cdot8p$	$-967\cdot1s$
Rot^{n} No. 219.		ω^{1} Scorpii		1854, April 15		10 40 7·78 G.M.T.		
$+4''\cdot58 = +\cdot836\Delta\alpha$	$+\cdot451\Delta\delta$	$-\cdot825\Delta\alpha'$	$-\cdot446\Delta\delta'$	$+\cdot262\Delta T$	$+\cdot437\Delta l$	$-\cdot002\Delta\phi'$	$+2081\cdot8p$	$-977\cdot3s$
Rot^{n} No. 221.		W.B. XI. 175		1854, May 7		6 56 4·27 G.M.T.		
$-2''\cdot92 = -\cdot747\Delta\alpha$	$+\cdot649\Delta\delta$	$+\cdot737\Delta\alpha'$	$-\cdot642\Delta\delta'$	$-\cdot357\Delta T$	$-\cdot513\Delta l$	$-\cdot008\Delta\phi'$	$+1557\cdot1p$	$-922\cdot3s$
Rot^{n} No. 222.		B.A.C. 4828		1854, May 11		5 4 22·99 G.M.T.		
$-4''\cdot89 = -\cdot974\Delta\alpha$	$-\cdot081\Delta\delta$	$+\cdot970\Delta\alpha'$	$+\cdot085\Delta\delta'$	$-\cdot465\Delta T$	$-\cdot530\Delta l$	$-\cdot008\Delta\phi'$	$-2993\cdot6p$	$-975\cdot8s$
Rot^{n} No. 223.		B.A.C. 4890		1854, May 11		12 44 12·02 G.M.T.		
$-3''\cdot98 = -\cdot952\Delta\alpha$	$-\cdot192\Delta\delta$	$+\cdot942\Delta\alpha'$	$+\cdot188\Delta\delta'$	$-\cdot344\Delta T$	$-\cdot505\Delta l$	$+\cdot009\Delta\phi'$	$+1564\cdot6p$	$-979\cdot2s$
Rot^{p} No. 225.		B.A.C. 4890		1854, May 11		13 42 31·64 G.M.T.		
$-7''\cdot83 = +\cdot462\Delta\alpha$	$-\cdot879\Delta\delta$	$-\cdot456\Delta\alpha'$	$+\cdot871\Delta\delta'$	$+\cdot372\Delta T$	$+\cdot469\Delta l$	$+\cdot010\Delta\phi'$	$-2474\cdot4p$	$-979\cdot6s$
Rot^{n} No. 226.		μ Piscium		1854, May 22		17 9 2·75 G.M.T.		
$+0''\cdot76 = -\cdot709\Delta\alpha$	$-\cdot703\Delta\delta$	$+\cdot703\Delta\alpha'$	$+\cdot696\Delta\delta'$	$-\cdot407\Delta T$	$-\cdot502\Delta l$	$+\cdot005\Delta\phi'$	$-2828\cdot4p$	$-916\cdot8s$
Rot^{n} No. 228.		κ Virginis		1854, June 7		5 27 4·62 G.M.T.		
$-3''\cdot71 = -\cdot197\Delta\alpha$	$+\cdot980\Delta\delta$	$+\cdot196\Delta\alpha'$	$-\cdot967\Delta\delta'$	$-\cdot329\Delta T$	$-\cdot346\Delta l$	$-\cdot016\Delta\phi'$	$+1165\cdot2p$	$-965\cdot2s$
Rot^{n} No. 230.		κ Virginis		1854, June 7		6 23 25·49 G.M.T.		
$+7''\cdot05 = +\cdot983\Delta\alpha$	$+\cdot066\Delta\delta$	$-\cdot969\Delta\alpha'$	$-\cdot066\Delta\delta'$	$+\cdot314\Delta T$	$+\cdot516\Delta l$	$+\cdot003\Delta\phi'$	$+1157\cdot4p$	$-965\cdot8s$
Rot^{n} No. 232.		κ Capricorni		1854, June 14		9 38 13·59 G.M.T.		
$-0''\cdot24 = -\cdot676\Delta\alpha$	$-\cdot694\Delta\delta$	$+\cdot670\Delta\alpha'$	$+\cdot694\Delta\delta'$	$-\cdot456\Delta T$	$-\cdot539\Delta l$	$+\cdot003\Delta\phi'$	$-3249\cdot3p$	$-978\cdot9s$
Rot^{n} No. 234.		κ Capricorni		1854, June 14		10 32 32·31 G.M.T		
$+0''\cdot26 = +\cdot893\Delta\alpha$	$-\cdot310\Delta\delta$	$-\cdot889\Delta\alpha'$	$+\cdot304\Delta\delta'$	$+\cdot417\Delta T$	$+\cdot488\Delta l$	$+\cdot013\Delta\phi'$	$+2109\cdot4p$	$-978\cdot4s$

Digitized by Google

Rotn No. 236.	77 Cancri			1854, June 28			h m s 5 26 45·28 G.M.T.	
+ 1″·91 = − ·896Δα	− ·259Δδ	+ ·889Δα′	+ ·261Δδ′	− ·318ΔT	− ·430Δl	+ ·010Δφ′	+ 1725·7p	− 886·6s
Rotn No. 237.	79 Cancri			1854, June 28			6 7 20·82 G.M.T.	
+ 0″·90 = − ·739Δα	− ·605Δδ	+ ·733Δα′	+ ·608Δδ′	− ·210ΔT	− ·304Δl	+ ·013Δφ′	+ 817·1p	− 886·7s
Rotn No. 238.	μ Libræ			1854, July 5			8 44 59·19 G.M.T.	
− 2″·76 = − ·735Δα	− ·653Δδ	+ ·727Δα′	+ ·643Δδ′	− ·144ΔT	− ·263Δl	+ ·014Δφ′	+ 341·5p	− 963·9s
Rotn No. 240.	μ Libræ			1854, July 5			9 15 41·30 G.M.T.	
− 16″·13 = − ·052Δα	− ·999Δδ	+ ·054Δα′	+ ·986Δδ′	+ ·169ΔT	+ ·193Δl	+ ·016Δφ′	− 1277·7p	− 964·2s
Rotn No. 241.	ψ³ Aquarii			1854, July 13			13 26 33·84 G.M.T.	
+ 0″·11 = − ·979Δα	− ·081Δδ	+ ·965Δα′	+ ·081Δδ′	− ·349ΔT	− ·556Δl	− ·001Δφ′	− 935·1p	− 968·7s
Rotn No. 243.	ψ³ Aquarii			1854, July 13			14 35 0·31 G.M.T.	
+ 1″·39 = + ·386Δα	+ ·920Δδ	− ·380Δα′	− ·905Δδ′	+ ·350ΔT	+ ·434Δl	− ·015Δφ′	+ 1272·8p	− 968·0s
Rotn No. 245.	Lal. 22678			1854, July 29			5 17 13·09 G.M.T.	
− 1″·04 = − ·680Δα	− ·731Δδ	+ ·673Δα′	+ ·725Δδ′	− ·046ΔT	− ·153Δl	+ ·014Δφ′	− 137·6p	− 910·2s
Rotn No. 247.	κ Capricorni			1854 August 8			5 43 36·06 G.M.T.	
− 4″·59 = − ·939Δα	− ·042Δδ	+ ·937Δα′	+ ·049Δδ′	− ·571ΔT	− ·604Δl	− ·009Δφ′	− 3089·0p	− 995·8s
Rotn No. 249.	κ Capricorni			1854 August 8			6 43 3·61 G.M.T.	
− 2″·69 = + ·870Δα	+ ·379Δδ	− ·864Δα′	− ·379Δδ′	+ ·520ΔT	+ ·624Δl	+ ·003Δφ′	+ 3169·0p	− 995·5s
Rotn No. 251.	B.A.C. 6138			1854 Sept. 1			9 10 9·96 G.M.T.	
− 7″·07 = − ·893Δα	+ ·078Δδ	+ ·883Δα′	− ·080Δδ′	− ·444ΔT	− ·597Δl	+ ·006Δφ′	+ 2223·7p	− 975·1s
Rotn No. 252.	B.A.C. 6562			1854, Sept. 2			8 34 38·44 G.M.T.	
− 5″·04 = − ·750Δα	− ·546Δδ	+ ·740Δα′	+ ·536Δδ′	− ·378ΔT	− ·525Δl	+ ·012Δφ′	+ ·653·4p	− 982·2s

Digitized by Google

Rotn No. 253. B.A.C. 6562 1854, Sept. 2 h m s 9 46 6·67 G.M.T.

$-4''\cdot28 = +\cdot883\Delta\alpha \quad -\cdot166\Delta\delta \quad -\cdot872\Delta\alpha' \quad +\cdot171\Delta\delta' \quad +\cdot419\Delta T \quad +\cdot592\Delta l \quad -\cdot003\Delta\phi' \quad -2056\cdot3p \quad -982\cdot5s$

Rotn No. 254. B.A.C. 6578 1854, Sept. 2 10 17 6·63 G.M.T.

$-3''\cdot26 = -\cdot501\Delta\alpha \quad -\cdot829\Delta\delta \quad +\cdot499\Delta\alpha' \quad +\cdot816\Delta\delta' \quad -\cdot348\Delta T \quad -\cdot372\Delta l \quad +\cdot018\Delta\phi' \quad +484\cdot2p \quad -982\cdot6s$

Rotn No. 255. κ Capricorni 1854, Oct. 29 7 47 20·72 G.M.T.

$-4''\cdot27 = -\cdot837\Delta\alpha \quad -\cdot455\Delta\delta \quad +\cdot827\Delta\alpha' \quad +\cdot447\Delta\delta' \quad -\cdot429\Delta T \quad -\cdot580\Delta l \quad +\cdot012\Delta\phi' \quad +838\cdot0p \quad -965\cdot5s$

Rotn No. 256. ψ^2 Aquarii 1854, Nov. 27 8 15 29·48 G.M.T.

$-2''\cdot92 = -\cdot920\Delta\alpha \quad -\cdot354\Delta\delta \quad +\cdot910\Delta\alpha' \quad +\cdot349\Delta\delta' \quad -\cdot433\Delta T \quad -\cdot573\Delta l \quad +\cdot011\Delta\phi' \quad +1251\cdot3p \quad -955\cdot7s$

Rotn No. 258. ψ^2 Aquarii 1854, Nov. 27 9 21 29·12 G.M.T.

$+2''\cdot64 = +\cdot638\Delta\alpha \quad +\cdot762\Delta\delta \quad -\cdot635\Delta\alpha' \quad -\cdot753\Delta\delta' \quad +\cdot472\Delta T \quad +\cdot522\Delta l \quad -\cdot017\Delta\phi' \quad -349\cdot0p \quad -955\cdot3s$

Rotn No. 259. υ Geminorum 1855, Jan. 3 10 30 7·25 G.M.T.

$+1''\cdot22 = +\cdot818\Delta\alpha \quad -\cdot408\Delta\delta \quad -\cdot806\Delta\alpha' \quad +\cdot404\Delta\delta' \quad +\cdot289\Delta T \quad +\cdot471\Delta l \quad +\cdot005\Delta\phi' \quad -598\cdot4p \quad -884\cdot5s$

Rotn No. 260. α^1 Libræ 1855, April 4 12 40 17·96 G.M.T.

$+1''\cdot04 = +\cdot641\Delta\alpha \quad -\cdot746\Delta\delta \quad -\cdot631\Delta\alpha' \quad +\cdot735\Delta\delta' \quad +\cdot356\Delta T \quad +\cdot493\Delta l \quad +\cdot012\Delta\phi' \quad -821\cdot6p \quad -929\cdot5s$

Rotn No. 261. α^2 Libræ 1855, April 4 11 28 30·84 G.M.T.

$-2''\cdot46 = -\cdot865\Delta\alpha \quad +\cdot440\Delta\delta \quad +\cdot854\Delta\alpha' \quad -\cdot431\Delta\delta' \quad -\cdot372\Delta T \quad -\cdot544\Delta l \quad -\cdot009\Delta\phi' \quad -287\cdot3p \quad -929\cdot1s$

Rotn No. 262. α^2 Libræ 1855, April 4 12 50 56·75 G.M.T.

$+1''\cdot35 = +\cdot670\Delta\alpha \quad -\cdot718\Delta\delta \quad -\cdot660\Delta\alpha' \quad +\cdot707\Delta\delta' \quad +\cdot357\Delta T \quad +\cdot502\Delta l \quad +\cdot011\Delta\phi' \quad -881\cdot6p \quad -929\cdot6s$

Rotn No. 263. φ Sagittarii 1855, April 8 12 39 21·43 G.M.T.

$-1''\cdot63 = -\cdot809\Delta\alpha \quad -\cdot410\Delta\delta \quad +\cdot799\Delta\alpha' \quad +\cdot412\Delta\delta' \quad -\cdot382\Delta T \quad -\cdot530\Delta l \quad -\cdot001\Delta\phi' \quad -2554\cdot6p \quad -960\cdot3s$

Rotn No. 264. φ Sagittarii 1855, April 8 13 41 12·98 G.M.T.

$+0''\cdot25 = +\cdot674\Delta\alpha \quad -\cdot651\Delta\delta \quad -\cdot668\Delta\alpha' \quad +\cdot639\Delta\delta' \quad +\cdot349\Delta T \quad +\cdot436\Delta l \quad +\cdot015\Delta\phi' \quad +937\cdot8p \quad -960\cdot6s$

Digitized by Google

Rot^{n} No. 265.	ϵ Capricorni					1855, May 8		h m s 14 0 34·53 G.M.T.	
$-2''\cdot02 = -\cdot454\Delta\alpha$	$-\cdot875\Delta\delta$	$+\cdot446\Delta\alpha'$	$+\cdot866\Delta\delta'$	$-\cdot319\Delta T$	$-\cdot437\Delta l$	$+\cdot010\Delta\phi'$	$-2065\cdot2p$	$-969\cdot9s$	
Rot^{n} No. 266.	τ Sagittarii					1856, April 25		14 9 24·68 G.M.T.	
$-4''\cdot76 = -\cdot875\Delta\alpha$	$-\cdot133\Delta\delta$	$+\cdot862\Delta\alpha'$	$+\cdot136\Delta\delta'$	$-\cdot352\Delta T$	$-\cdot550\Delta l$	$-\cdot001\Delta\phi'$	$-996\cdot9p$	$-936\cdot2s$	
Rot^{n} No. 267.	τ Sagittarii					1856, April 25		15 39 35·32 G.M.T.	
$+4''\cdot16 = +\cdot882\Delta\alpha$	$+\cdot048\Delta\delta$	$-\cdot868\Delta\alpha'$	$-\cdot044\Delta\delta'$	$+\cdot343\Delta T$	$+\cdot551\Delta l$	$-\cdot001\Delta\phi'$	$-143\cdot9p$	$-936\cdot8s$	
Rot^{n} No. 268.	B.A.C. 6127					1856, Sept. 8		7 54 27·39 G.M.T.	
$-4''\cdot09 = -\cdot760\Delta\alpha$	$+\cdot503\Delta\delta$	$+\cdot748\Delta\alpha'$	$-\cdot498\Delta\delta'$	$-\cdot299\Delta T$	$-\cdot473\Delta l$	$-\cdot003\Delta\phi'$	$+1696\cdot5p$	$-927\cdot3s$	
Rot^{n} No. 269.	B.A.C. 6127					1856, Sept. 8		8 56 42·33 G.M.T.	
$+2''\cdot71 = +\cdot618\Delta\alpha$	$+\cdot712\Delta\delta$	$-\cdot615\Delta\alpha'$	$-\cdot698\Delta\delta'$	$+\cdot335\Delta T$	$+\cdot373\Delta l$	$-\cdot015\Delta\phi'$	$-981\cdot7p$	$-927\cdot9s$	
Rot^{n} No. 270.	η Tauri					1856, Nov. 12		7 42 45·33 G.M.T.	
$-1''\cdot74 = -\cdot904\Delta\alpha$	$-\cdot194\Delta\delta$	$+\cdot895\Delta\alpha'$	$+\cdot186\Delta\delta'$	$-\cdot487\Delta T$	$-\cdot619\Delta l$	$-\cdot005\Delta\phi'$	$-2720\cdot8p$	$-993\cdot0s$	
Rot^{n} No. 271.	η Tauri					1856, Nov. 12		8 47 26·27 G.M.T.	
$-12''\cdot10 = +\cdot623\Delta\alpha$	$+\cdot736\Delta\delta$	$-\cdot617\Delta\alpha'$	$-\cdot730\Delta\delta'$	$+\cdot445\Delta T$	$+\cdot537\Delta l$	$-\cdot004\Delta\phi'$	$+3209\cdot0p$	$-992\cdot6s$	
Rot^{n} No. 272.	η Virginis					1857, Jan. 15		12 44 58·76 G.M.T.	
$-1''\cdot89 = -\cdot988\Delta\alpha$	$-\cdot155\Delta\delta$	$+\cdot978\Delta\alpha'$	$+\cdot154\Delta\delta'$	$-\cdot243\Delta T$	$-\cdot398\Delta l$	$-\cdot003\Delta\phi'$	$-1939\cdot9p$	$-893\cdot4s$	
Rot^{n} No. 273.	η Virginis					1857, Jan. 15		13 37 57·24 G.M.T.	
$-0''\cdot18 = -\cdot017\Delta\alpha$	$-\cdot999\Delta\delta$	$+\cdot017\Delta\alpha'$	$+\cdot988\Delta\delta'$	$+\cdot227\Delta T$	$+\cdot230\Delta l$	$+\cdot013\Delta\phi'$	$-1843\cdot9p$	$-893\cdot2s$	
Rot^{n} No. 274.	ϕ Geminorum					1857, Feb. 6		11 3 0·14 G.M.T.	
$-1''\cdot77 = -\cdot849\Delta\alpha$	$-\cdot323\Delta\delta$	$+\cdot836\Delta\alpha'$	$+\cdot322\Delta\delta'$	$-\cdot286\Delta T$	$-\cdot479\Delta l$	$+\cdot007\Delta\phi'$	$+210\cdot9p$	$-937\cdot5s$	
Rot^{n} No. 275.	σ Scorpii					1857, March 16		11 3 51·19 G.M.T.	
$-2''\cdot75 = -\cdot896\Delta\alpha$	$-\cdot117\Delta\delta$	$+\cdot889\Delta\alpha'$	$+\cdot124\Delta\delta'$	$-\cdot372\Delta T$	$-\cdot467\Delta l$	$-\cdot006\Delta\phi'$	$-2565\cdot2p$	$-890\cdot4s$	

Digitized by Google

Rotn No. 276. σ Scorpii 1857, March 16 h m s 12 3 30·73 G.M.T.

$+ 0''.17 = + .466\Delta\alpha - .856\Delta\delta - .465\Delta\alpha + .844\Delta\delta' + .333\Delta T + .347\Delta l + .016\Delta\phi' + 348.1p - 890.6s$

Rotn No. 277. α Scorpii 1857, March 16 16 44 14·64 G.M.T.

$- 2''.08 = - .889\Delta\alpha + .134\Delta\delta + .876\Delta\alpha' - .132\Delta\delta' - .308\Delta T - .498\Delta l + .001\Delta\phi' + 947.2p - 891.7s$

Rotn No. 278. B.A.C. 6127 1857, March 18 10 34 59·53 G.M.T.

$+ 7''.75 = - .010\Delta\alpha - 1.000\Delta\delta + .004\Delta\alpha' + .997\Delta\delta' + .099\Delta T + .003\Delta l + .011\Delta\phi' - 1773.1p - 906.4s$

Rotn No. 279. B.A.C. 6127 1857, March 18 10 45 27·14 G.M.T.

$+ 1''.88 = + .333\Delta\alpha + .925\Delta\delta - .327\Delta\alpha' - .924\Delta\delta' + .104\Delta T + .188\Delta l - .007\Delta\phi' + 2608.2p - 906.4s$

Rotn No. 280. τ Sagittarii 1857, March 19 11 42 34·92 G.M.T.

$+ 4''.00 = + .498\Delta\alpha + .825\Delta\delta - .493\Delta\alpha' - .826\Delta\delta' + .271\Delta T + .344\Delta l - .005\Delta\phi' + 2990.7p - 918.9s$

Rotn No. 281. κ Aurigæ 1857, March 31 8 7 39·13 G.M.T.

$- 1''.03 = - .742\Delta\alpha - .533\Delta\delta + .733\Delta\alpha' + .536\Delta\delta' - .339\Delta T - .482\Delta l + .012\Delta\phi' + 765.6p - 955.9s$

Rotn No. 282. φ Geminorum 1857, April 29 5 16 59·98 G.M.T.

$- 2''.07 = - .895\Delta\alpha + .048\Delta\delta + .882\Delta\alpha' - .048\Delta\delta' - .360\Delta T - .557\Delta l + .003\Delta\phi' + 1089.4p - 948.0s$

Rotn No. 283. β Virginis 1857, May 31 10 14 0·61 G.M.T.

$- 1''.73 = - .011\Delta\alpha + 1.000\Delta\delta + .012\Delta\alpha' - .995\Delta\delta' - .252\Delta T - .246\Delta l - .013\Delta\phi' + 1905.8p - 897.8s$

Rotn No. 284. α Scorpii 1857, June 6 11 35 26·40 G.M.T.

$- 2''.53 = - .716\Delta\alpha + .603\Delta\delta + .705\Delta\alpha' - .595\Delta\delta' - .286\Delta T - .452\Delta l - .007\Delta\phi' + 1142.3p - 889.2s$

Rotn No. 285. α Virginis 1857, July 27 6 11 58·60 G.M.T.

$- 2''.24 = - .403\Delta\alpha + .912\Delta\delta + .397\Delta\alpha' - .902\Delta\delta' - .303\Delta T - .387\Delta l - .011\Delta\phi' + 1951.3p - 893.1s$

Rotn No. 286. γ Capricorni 1857, Nov. 23 5 48 5·41 G.M.T.

$- 4''.45 = - .936\Delta\alpha - .187\Delta\delta + .924\Delta\alpha' + .184\Delta\delta' - .339\Delta T - .517\Delta l + .007\Delta\phi' + 973.0p - 918.0s$

Digitized by Google

Rot^{n} No. 287.			γ Capricorni			1857, Nov. 23		h m s 6 57 31·09	G.M.T.
+ 0″·89 =	+ ·442Δα	+ ·886Δδ	− ·439Δα′	− ·874Δδ′	+ ·374ΔT	+ ·409Δl	− ·016Δφ′	+ 156·2p	− 918·5s
Rot^{n} No. 288.			α Scorpii			1858, March 6		9 54 31·30	G.M.T.
− 2″·80 =	− ·894Δα	− ·010Δδ	+ ·895Δα′	+ ·019Δδ′	− ·496ΔT	− ·484Δl	− ·009Δφ′	− 2730·0p	− 887·5s
Rot^{n} No. 289.			α Scorpii			1858, March 6		10 48 44·98	G.M.T.
+ 4″·19 =	+ ·664Δα	− ·669Δδ	− ·667Δα′	+ ·661Δδ′	+ ·453ΔT	+ ·422Δl	+ ·015Δφ′	+ 1045·0p	− 887·4s
Rot^{n} No. 290.			3 Sagittarii			1858, Oct. 12		8 58 12·87	G.M.T.
− 3″·75 =	− ·828Δα	− ·342Δδ	+ ·830Δα′	+ ·336Δδ′	− ·495ΔT	− ·465Δl	+ ·012Δφ′	+ 2011·9p	− 888·2s
Rot^{n} No. 291.			h^2 Sagittarii			1858, Oct. 14		10 31 31·20	G.M.T.
− 4″·86 =	− ·882Δα	− ·208Δδ	+ ·882Δα′	+ ·203Δδ′	− ·501ΔT	− ·494Δl	+ ·011Δφ′	+ 2324·4p	− 888·3s
Rot^{n} No. 292.			c Leonis			1859, Jan. 21		8 38 47·11	G.M.T.
− 3″·13 =	− ·947Δα	+ ·305Δδ	+ ·942Δα′	− ·306Δδ′	− ·361ΔT	− ·594Δl	− ·013Δφ′	− 2098·1p	− 979·1s
Rot^{n} No. 293.			c Leonis			1859, Jan. 21		9 40 45·28	G.M.T.
+ 1″·81 =	+ ·750Δα	− ·656Δδ	− ·744Δα′	+ ·653Δδ′	+ ·486ΔT	+ ·586Δl	+ ·015Δφ′	+ 505·9p	− 978·5s
Rot^{n} No. 294.			η Piscium			1859, Feb. 8		7 59 42·17	G.M.T.
− 2″·41 =	− ·348Δα	− ·934Δδ	+ ·344Δα′	+ ·934Δδ′	− ·322ΔT	− ·387Δl	+ ·015Δφ′	− 897·8p	− 927·3s
Rot^{n} No. 295.			φ Tauri			1859, Feb. 11		9 24 0·61	G.M.T.
+ 2″·35 =	− ·352Δα	+ ·919Δδ	+ ·354Δα′	− ·915Δδ′	− ·168ΔT	− ·138Δl	− ·006Δφ′	+ 3244·6p	− 963·9s
Rot^{n} No. 296.			ψ Virginis			1859, May 13		5 29 6·14	G.M.T.
− 0″·65 =	+ ·264Δα	+ ·964Δδ	− ·260Δα′	− ·952Δδ′	− ·167ΔT	− ·106Δl	− ·013Δφ′	+ 1998·1p	− 943·1s
Rot^{n} No. 297.			ψ Virginis			1859, May 13		5 59 0·02	G.M.T.
+ 12″·39 =	+ ·885Δα	+ ·443Δδ	− ·874Δα′	− ·438Δδ′	+ ·175ΔT	+ ·341Δl	− ·002Δφ′	+ 2064·2p	− 942·9s

Digitized by Google

Rotn No. 298. η Piscium 1859, Aug. 18 h m s 11 7 19·53 G.M.T.

$+0''\cdot34 = +\cdot428\Delta\alpha - \cdot898\Delta\delta - \cdot422\Delta\alpha' + \cdot893\Delta\delta' - \cdot076\Delta T + \cdot017\Delta l + \cdot013\Delta\phi' - 1108\cdot5p - 911\cdot5s$

Rotn No. 299. η Piscium 1859, Aug. 18 11 20 59·55 G.M.T.

$+0''\cdot93 = +\cdot721\Delta\alpha - \cdot671\Delta\delta - \cdot712\Delta\alpha' + \cdot667\Delta\delta' + \cdot080\Delta T + \cdot210\Delta l + \cdot013\Delta\phi' - 69\cdot6p - 911\cdot6s$

Rotn No. 300. α Scorpii 1859, Oct. 28 4 27 21·25 G.M.T.

$-2''\cdot57 = -\cdot847\Delta\alpha + \cdot328\Delta\delta + \cdot838\Delta\alpha' - \cdot328\Delta\delta' - \cdot401\Delta T - \cdot533\Delta l + \cdot002\Delta\phi' + 2564\cdot4p - 928\cdot8s$

Rotn No. 301. α Scorpii 1859, Oct. 28 5 31 44·33 G.M.T.

$+4''\cdot84 = +\cdot839\Delta\alpha + \cdot352\Delta\delta - \cdot837\Delta\alpha' - \cdot341\Delta\delta' + \cdot454\Delta T + \cdot481\Delta l - \cdot013\Delta\phi' - 2079\cdot0p - 928\cdot3s$

Rotn No. 302. η Piscium 1859, Nov. 8 7 14 50·28 G.M.T.

$-0''\cdot52 = -\cdot174\Delta\alpha - \cdot984\Delta\delta + \cdot173\Delta\alpha' + \cdot974\Delta\delta' - \cdot290\Delta T - \cdot300\Delta l + \cdot010\Delta\phi' + 2634\cdot4p - 920\cdot9s$

Rotn No. 303. η Piscium 1859, Nov. 8 8 16 5·50 G.M.T.

$+2''\cdot44 = +\cdot970\Delta\alpha - \cdot043\Delta\delta - \cdot957\Delta\alpha' + \cdot042\Delta\delta' + \cdot281\Delta T + \cdot481\Delta l + \cdot002\Delta\phi' + 428\cdot8p - 921\cdot3s$

Rotn No. 304. σ Scorpii 1859, Dec. 21 14 47 4·81 G.M.T.

$-1''\cdot64 = -\cdot878\Delta\alpha - \cdot220\Delta\delta + \cdot876\Delta\alpha' + \cdot228\Delta\delta' - \cdot473\Delta T - \cdot501\Delta l - \cdot006\Delta\phi' - 3134\cdot1p - 922\cdot3s$

Rotn No. 305. α Scorpii 1859, Dec. 21 19 2 39·62 G.M.T.

$-1''\cdot33 = -\cdot675\Delta\alpha + \cdot660\Delta\delta + \cdot668\Delta\alpha' - \cdot646\Delta\delta' - \cdot349\Delta T - \cdot451\Delta l - \cdot014\Delta\phi' - 674\cdot6p - 920\cdot9s$

Rotn No. 306. υ Leonis 1860, Jan. 12 12 57 10·71 G.M.T.

$-4''\cdot44 = -\cdot295\Delta\alpha + \cdot956\Delta\delta + \cdot291\Delta\alpha' - \cdot943\Delta\delta' - \cdot363\Delta T - \cdot421\Delta l - \cdot015\Delta\phi' + 1489\cdot9p - 978\cdot1s$

Rotn No. 307. A Scorpii 1860, Feb. 13 15 46 26·63 G.M.T.

$-1''\cdot27 = -\cdot698\Delta\alpha + \cdot639\Delta\delta + \cdot689\Delta\alpha' - \cdot626\Delta\delta' - \cdot341\Delta T - \cdot477\Delta l - \cdot012\Delta\phi' - 299\cdot4p - 930\cdot5s$

Rotn No. 308. υ Leonis 1860, March 7 9 35 3·02 G.M.T.

$-0''\cdot40 = -\cdot236\Delta\alpha + \cdot972\Delta\delta + \cdot233\Delta\alpha' - \cdot959\Delta\delta' - \cdot366\Delta T - \cdot414\Delta l - \cdot015\Delta\phi' + 1684\cdot9p - 1002\cdot7s$

Digitized by Google

Rot^{n} No. 309.			υ Leonis			1860, March 7		h m s 10 34 17·15 G.M.T.	
$+1''\cdot72 = +\cdot998\Delta\alpha$	$-\cdot069\Delta\delta$	$-\cdot983\Delta\alpha'$	$+\cdot068\Delta\delta'$	$+\cdot364\Delta T$	$+\cdot584\Delta l$	$+\cdot003\Delta\phi'$	$+ 365\cdot2p$	$-1002\cdot5s$	
Rot^{n} No. 310.			σ Scorpii			1860, March 12		9 41 13·69 G.M.T.	
$-1''\cdot65 = -\cdot892\Delta\alpha$	$-\cdot137\Delta\delta$	$+\cdot891\Delta\alpha'$	$+\cdot145\Delta\delta'$	$-\cdot511\Delta T$	$-\cdot529\Delta l$	$-\cdot007\Delta\phi'$	$-3073\cdot8p$	$- 938\cdot1s$	
Rot^{n} No. 311.			Washington 6752			1860, March 12		10 32 23·05 G.M.T.	
$+0''\cdot19 = +\cdot648\Delta\alpha$	$-\cdot695\Delta\delta$	$-\cdot649\Delta\alpha'$	$+\cdot686\Delta\delta'$	$+\cdot471\Delta T$	$+\cdot448\Delta l$	$+\cdot016\Delta\phi'$	$+1014\cdot8p$	$- 937\cdot6s$	
Rot^{n} No. 312.			σ Scorpii			1860, March 12		10 32 53·66 G.M.T.	
$+2''\cdot34 = +\cdot648\Delta\alpha$	$-\cdot694\Delta\delta$	$-\cdot650\Delta\alpha'$	$+\cdot686\Delta\delta'$	$+\cdot471\Delta T$	$+\cdot448\Delta l$	$+\cdot016\Delta\phi'$	$+1017\cdot8p$	$- 937\cdot6s$	
Rot^{n} No. 313.			α Scorpii			1860, March 12		14 0 47·29 G.M.T.	
$+0''\cdot03 = -\cdot624\Delta\alpha$	$+\cdot720\Delta\delta$	$+\cdot617\Delta\alpha'$	$-\cdot706\Delta\delta'$	$-\cdot326\Delta T$	$-\cdot428\Delta l$	$-\cdot014\Delta\phi'$	$- 444\cdot4p$	$- 935\cdot4s$	
Rot^{n} No. 315.			α Scorpii			1860, March 12		15 16 4·61 G.M.T.	
$+4''\cdot74 = +\cdot868\Delta\alpha$	$+\cdot255\Delta\delta$	$-\cdot854\Delta\alpha'$	$-\cdot250\Delta\delta'$	$+\cdot305\Delta T$	$+\cdot508\Delta l$	$-\cdot003\Delta\phi'$	$+ 441\cdot0p$	$- 934\cdot6s$	
Rot^{n} No. 316.			B.A.C. 1648			1860, March 28		6 56 54·18 G.M.T.	
$+3''\cdot76 = -\cdot595\Delta\alpha$	$-\cdot745\Delta\delta$	$+\cdot585\Delta\alpha'$	$+\cdot746\Delta\delta'$	$-\cdot230\Delta T$	$-\cdot373\Delta l$	$+\cdot012\Delta\phi'$	$- 413\cdot7p$	$- 934\cdot2s$	
Rot^{n} No. 317.			Lalande 13554			1860, April 26		4 47 25·04 G.M.T.	
$+1''\cdot07 = -\cdot662\Delta\alpha$	$+\cdot683\Delta\delta$	$+\cdot654\Delta\alpha'$	$-\cdot678\Delta\delta'$	$-\cdot354\Delta T$	$-\cdot474\Delta l$	$-\cdot004\Delta\phi'$	$+2763\cdot1p$	$- 948\cdot1s$	
Rot^{n} No. 318.			μ^{2} Cancri			1860, April 27		8 42 46·73 G.M.T.	
$-3''\cdot22 = -\cdot844\Delta\alpha$	$-\cdot425\Delta\delta$	$+\cdot836\Delta\alpha'$	$+\cdot427\Delta\delta'$	$-\cdot318\Delta T$	$-\cdot429\Delta l$	$+\cdot002\Delta\phi'$	$+1428\cdot3p$	$- 958\cdot0s$	
Rot^{n} No. 319.			υ Leonis			1860, May 1		4 38 10·86 G.M.T.	
$-2''\cdot27 = -\cdot561\Delta\alpha$	$+\cdot828\Delta\delta$	$+\cdot555\Delta\alpha'$	$-\cdot819\Delta\delta'$	$-\cdot443\Delta T$	$-\cdot530\Delta l$	$-\cdot016\Delta\phi'$	$+ 473\cdot4p$	$- 981\cdot6s$	
Rot^{n} No. 320.			υ Leonis			1860, May 1		5 46 4·87 G.M.T.	
$-0''\cdot77 = +\cdot949\Delta\alpha$	$-\cdot314\Delta\delta$	$-\cdot937\Delta\alpha'$	$+\cdot310\Delta\delta'$	$+\cdot417\Delta T$	$+\cdot600\Delta l$	$+\cdot009\Delta\phi'$	$+ 688\cdot3p$	$- 981\cdot7s$	

Digitized by Google

Rot^{n} No. 321. λ Sagittarii 1860, May 8 h m s 8 52 25·90 G.M.T.

$+3''\cdot22 = +\cdot762\Delta\alpha \; -\cdot531\Delta\delta \; -\cdot762\Delta\alpha' \; +\cdot523\Delta\delta' \; -\cdot481\Delta T \; -\cdot486\Delta l \; +\cdot015\Delta\phi' \; +1585\cdot5p \; -926\cdot1s$

Rot^{n} No. 322. δ Cancri 1860, May 25 5 49 28·12 G.M.T.

$-0''\cdot72 = -\cdot557\Delta\alpha \; +\cdot810\Delta\delta \; +\cdot553\Delta\alpha' \; -\cdot803\Delta\delta' \; -\cdot422\Delta T \; -\cdot482\Delta l \; -\cdot005\Delta\phi' \; +3196\cdot1p \; -963\cdot0s$

Rot^{n} No. 323. δ Cancri 1860, May 25 6 52 0·13 G.M.T.

$+3''\cdot54 = +\cdot937\Delta\alpha \; -\cdot170\Delta\delta \; -\cdot930\Delta\alpha' \; +\cdot164\Delta\delta' \; -\cdot616\Delta T \; -\cdot506\Delta l \; -\cdot006\Delta\phi' \; -2789\cdot2p \; -963\cdot2s$

Rot^{n} No. 324. A^1 Ophiuchi 1860, June 3 13 57 58·60 G.M.T.

$-3''\cdot10 = -\cdot851\Delta\alpha \; +\cdot308\Delta\delta \; +\cdot840\Delta\alpha' \; -\cdot306\Delta\delta' \; -\cdot373\Delta T \; -\cdot535\Delta l \; +\cdot001\Delta\phi' \; +2137\cdot1p \; -939\cdot2s$

Rot^{n} No. 325. A^2 Ophiuchi 1860, June 3 13 57 59·60 G.M.T.

$-3''\cdot96 = -\cdot851\Delta\alpha \; +\cdot308\Delta\delta \; +\cdot840\Delta\alpha' \; -\cdot306\Delta\delta' \; -\cdot373\Delta T \; -\cdot535\Delta l \; +\cdot001\Delta\phi' \; +2137\cdot1p \; -939\cdot2s$

Rot^{n} No. 326. A^1 Ophiuchi 1860, June 3 15 3 18·86 G.M.T.

$-1''\cdot50 = +\cdot751\Delta\alpha \; +\cdot543\Delta\delta \; -\cdot748\Delta\alpha' \; -\cdot531\Delta\delta' \; -\cdot506\Delta T \; -\cdot463\Delta l \; -\cdot015\Delta\phi' \; -1517\cdot1p \; -938\cdot7s$

Rot^{n} No. 327. A^2 Ophiuchi 1860, June 3 15 3 21·85 G.M.T.

$+4''\cdot16 = +\cdot751\Delta\alpha \; +\cdot540\Delta\delta \; -\cdot748\Delta\alpha' \; -\cdot531\Delta\delta' \; -\cdot506\Delta T \; -\cdot463\Delta l \; -\cdot015\Delta\phi' \; -1517\cdot1p \; -938\cdot7s$

Rot^{n} No. 328. A^1, A^2 Ophiuchi 1860, Aug. 24 9 24 21·84 G.M.T.

$-3''\cdot19 = -\cdot760\Delta\alpha \; +\cdot528\Delta\delta \; -\cdot751\Delta\alpha' \; -\cdot525\Delta\delta' \; -\cdot328\Delta T \; -\cdot466\Delta l \; -\cdot001\Delta\phi' \; +2523\cdot2p \; -929\cdot4s$

Rot^{n} No. 329. θ Aquarii 1860, Aug. 30 6 9 31·54 G.M.T.

$+2''\cdot83 = +\cdot942\Delta\alpha \; +\cdot302\Delta\delta \; -\cdot936\Delta\alpha' \; -\cdot301\Delta\delta' \; +\cdot399\Delta T \; +\cdot493\Delta l \; +\cdot003\Delta\phi' \; +2764\cdot7p \; -886\cdot3s$

Rot^{n} No. 330. 22 Scorpii 1860, Oct. 17 7 16 0·55 G.M.T.

$-2''\cdot40 = -\cdot579\Delta\alpha \; -\cdot767\Delta\delta \; +\cdot583\Delta\alpha' \; +\cdot761\Delta\delta' \; -\cdot394\Delta T \; -\cdot328\Delta l \; +\cdot016\Delta\phi' \; +557\cdot8p \; -964\cdot9s$

Rot^{n} No. 332. Lal. 38096 1860, Nov. 17 7 10 11·55 G.M.T.

$-6''\cdot60 = -\cdot909\Delta\alpha \; -\cdot237\Delta\delta \; +\cdot904\Delta\alpha' \; +\cdot232\Delta\delta' \; -\cdot464\Delta T \; -\cdot533\Delta l \; +\cdot011\Delta\phi' \; +2157\cdot7p \; -921\cdot6s$

Digitized by Google

Rot^{n} No. 333.	Lal. 42073				1860, Nov. 19			h m s 6 11 22·24 G.M.T.	
$-5''\cdot62 = -\cdot942\Delta\alpha$	$+\cdot264\Delta\delta$	$+\cdot931\Delta\alpha'$	$-\cdot260\Delta\delta'$	$-\cdot224\Delta T$	$-\cdot398\Delta l$	$+\cdot000\Delta\phi'$	$+1574\cdot0p$	$-899\cdot7s$	
Rot^{n} No. 334.	Lal. 42160				1860, Nov. 19			8 40 49·34 G.M.T.	
$-1''\cdot58 = +\cdot230\Delta\alpha$	$-\cdot972\Delta\delta$	$-\cdot227\Delta\alpha'$	$+\cdot965\Delta\delta'$	$-\cdot139\Delta T$	$-\cdot085\Delta l$	$+\cdot012\Delta\phi'$	$-2102\cdot4p$	$-898\cdot8s$	
Rot^{n} No. 335.	Lal. 45233				1860, Nov. 21			8 44 26·49 G.M.T.	
$-2''\cdot77 = -\cdot087\Delta\alpha$	$-\cdot996\Delta\delta$	$+\cdot087\Delta\alpha'$	$+\cdot987\Delta\delta'$	$-\cdot245\Delta T$	$-\cdot254\Delta l$	$+\cdot014\Delta\phi'$	$-1596\cdot0p$	$-887\cdot0s$	
Rot^{n} No. 336.	Lal. 46737				1860, Nov. 22			8 49 21·73 G.M.T.	
$-4''\cdot36 = -\cdot996\Delta\alpha$	$+\cdot070\Delta\delta$	$+\cdot985\Delta\alpha'$	$-\cdot070\Delta\delta'$	$-\cdot270\Delta T$	$-\cdot427\Delta l$	$+\cdot004\Delta\phi'$	$-1746\cdot0p$	$-885\cdot6s$	
Rot^{n} No. 337.	Lal. 46742				1860, Nov. 22			9 0 18·43 G.M.T.	
$-8''\cdot07 = -\cdot998\Delta\alpha$	$+\cdot029\Delta\delta$	$+\cdot988\Delta\alpha'$	$-\cdot028\Delta\delta'$	$-\cdot285\Delta T$	$-\cdot437\Delta l$	$+\cdot005\Delta\phi'$	$-1768\cdot0p$	$-885\cdot6s$	
Rot^{n} No. 338.	Lal. 2312				1860, Nov. 24			6 18 56·47 G.M.T.	
$-5''\cdot11 = -\cdot890\Delta\alpha$	$-\cdot410\Delta\delta$	$+\cdot879\Delta\alpha'$	$+\cdot404\Delta\delta'$	$-\cdot336\Delta T$	$-\cdot498\Delta l$	$+\cdot002\Delta\phi'$	$-1824\cdot0p$	$-889\cdot6s$	
Rot^{n} No. 339.	Piazzi III. 175				1860, Nov. 27			8 12 14·87 G.M.T.	
$-4''\cdot34 = -\cdot879\Delta\alpha$	$-\cdot274\Delta\delta$	$+\cdot868\Delta\alpha'$	$+\cdot267\Delta\delta'$	$-\cdot358\Delta T$	$-\cdot520\Delta l$	$-\cdot002\Delta\phi'$	$-1952\cdot8p$	$-909\cdot1s$	
Rot^{n} No. 340.	Lal. 7114				1860, Nov. 27			8 42 44·96 G.M.T.	
$-3''\cdot82 = -\cdot913\Delta\alpha$	$-\cdot050\Delta\delta$	$+\cdot900\Delta\alpha'$	$-\cdot046\Delta\delta'$	$-\cdot331\Delta T$	$-\cdot519\Delta l$	$-\cdot003\Delta\phi'$	$-1066\cdot4p$	$-909\cdot3s$	
Rot^{n} No. 341.	μ Geminorum				1862, Dec. 7			9 51 8·12 G.M.T.	
$-2''\cdot50 = -\cdot922\Delta\alpha$	$+\cdot115\Delta\delta$	$+\cdot910\Delta\alpha'$	$-\cdot119\Delta\delta'$	$-\cdot322\Delta T$	$-\cdot493\Delta l$	$-\cdot006\Delta\phi'$	$-1071\cdot7p$	$-882\cdot7s$	
Rot^{n} No. 342.	μ Geminorum				1862, Dec. 7			11 26 44·89 G.M.T.	
$+3''\cdot31 = +\cdot925\Delta\alpha$	$-\cdot087\Delta\delta$	$-\cdot912\Delta\alpha'$	$+\cdot086\Delta\delta'$	$+\cdot298\Delta T$	$+\cdot493\Delta l$	$+\cdot002\Delta\phi'$	$+96\cdot8p$	$-882\cdot8s$	
Rot^{n} No. 343.	p^{6} Leonis				1862, Dec. 13			12 28 24·05 G.M.T.	
$+6''\cdot79 = -\cdot754\Delta\alpha$	$+\cdot657\Delta\delta$	$+\cdot748\Delta\alpha'$	$-\cdot653\Delta\delta'$	$-\cdot423\Delta T$	$-\cdot504\Delta l$	$-\cdot015\Delta\phi'$	$-563\cdot2p$	$-921\cdot0s$	

Digitized by Google

Rotn No. 344. p^5 Leonis 1862, Dec. 13 h m s 13 42 29·12 G.M.T.

$-29''\cdot29 = +\cdot948\Delta\alpha \; -\cdot317\Delta\delta \; -\cdot939\Delta\alpha' \; +\cdot314\Delta\delta' \; +\cdot383\Delta T \; -\cdot531\Delta l \; +\cdot010\Delta\phi' \; +1113\cdot0p \; -921\cdot6s$

Rotn No. 345. ζ Arietis 1863, Jan. 27 8 0 15·87 G.M.T.

$-\;1''\cdot88 = -\cdot940\Delta\alpha \; -\cdot031\Delta\delta \; +\cdot930\Delta\alpha' \; +\cdot029\Delta\delta' \; -\cdot339\Delta T \; -\cdot497\Delta l \; +\cdot006\Delta\phi' \; +1622\cdot2p \; -895\cdot9s$

Rot. No. 346. 58 Ophiuchi 1863, March 12 10 20 35·03 G.M.T.

$-\;1''\cdot89 = +\cdot920\Delta\alpha \; +\cdot120\Delta\delta \; -\cdot922\Delta\alpha' \; -\cdot124\Delta\delta' \; +\cdot615\Delta T \; +\cdot587\Delta l \; +\cdot008\Delta\phi' \; +3131\cdot8p \; -968\cdot1s$

Rotn No. 347. ω Ophiuchi 1863, April 7 11 33 33·29 G.M.T.

$+\;1''\cdot01 = -\cdot805\Delta\alpha \; -\cdot500\Delta\delta \; +\cdot794\Delta\alpha' \; +\cdot498\Delta\delta' \; -\cdot320\Delta T \; -\cdot490\Delta l \; +\cdot003\Delta\phi' \; -2092\cdot3p \; -970\cdot0s$

Rotn No. 348. 58 Ophiuchi 1863, April 8 16 45 35·68 G.M.T.

$+\;1''\cdot67 = -\cdot917\Delta\alpha \; -\cdot151\Delta\delta \; +\cdot905\Delta\alpha' \; +\cdot143\Delta\delta' \; -\cdot398\Delta T \; -\cdot590\Delta l \; +\cdot006\Delta\phi' \; +1017\cdot3p \; -971\cdot4s$

Rotn No. 349. 58 Ophiuchi 1863, April 8 18 3 15·39 G.M.T.

$-\;5''\cdot48 = +\cdot913\Delta\alpha \; +\cdot183\Delta\delta \; -\cdot903\Delta\alpha' \; -\cdot175\Delta\delta' \; +\cdot440\Delta T \; +\cdot588\Delta l \; -\cdot009\Delta\phi' \; -1782\cdot7p \; -971\cdot3s$

Rotn No. 350. ω^2 Scorpii 1863, May 4 10 17 10·54 G.M.T.

$-\;0''\cdot28 = -\cdot550\Delta\alpha \; -\cdot808\Delta\delta \; +\cdot541\Delta\alpha' \; +\cdot797\Delta\delta' \; -\cdot160\Delta T \; -\cdot301\Delta l \; +\cdot011\Delta\phi' \; -1481\cdot2p \; -981\cdot2s$

Rotn No. 351. ω^2 Scorpii 1863, June 28 6 50 22·40 G.M.T.

$-\;0''\cdot88 = -\cdot647\Delta\alpha \; -\cdot722\Delta\delta \; +\cdot636\Delta\alpha' \; +\cdot712\Delta\delta' \; -\cdot209\Delta T \; -\cdot370\Delta l \; +\cdot010\Delta\phi' \; -1444\cdot0p \; -983\cdot4s$

Rotn No. 352. ω^2 Scorpii 1863, June 28 7 31 33·88 G.M.T.

$+\;2''\cdot88 = +\cdot287\Delta\alpha \; -\cdot952\Delta\delta \; -\cdot284\Delta\alpha' \; +\cdot936\Delta\delta' \; +\cdot198\Delta T \; +\cdot249\Delta l \; +\cdot017\Delta\phi' \; -\;615\cdot5p \; -983\cdot7s$

Rotn No. 353. 21 Sagittarii 1863, June 30 10 53 50·89 G.M.T.

$+\;1''\cdot26 = -\cdot746\Delta\alpha \; -\cdot601\Delta\delta \; +\cdot735\Delta\alpha' \; +\cdot591\Delta\delta' \; -\cdot373\Delta T \; -\cdot546\Delta l \; +\cdot011\Delta\phi' \; -\;245\cdot7p \; -1002\cdot6s$

Rotn No. 354. 21 Sagittarii 1863, June 30 12 5 1·88 G.M.T.

$+\;1''\cdot44 = +\cdot913\Delta\alpha \; -\cdot211\Delta\delta \; -\cdot899\Delta\alpha' \; +\cdot211\Delta\delta' \; +\cdot395\Delta T \; +\cdot601\Delta l \; -\cdot000\Delta\phi' \; -1411\cdot7p \; -1002\cdot8s$

Digitized by Google

Rot^{n} No. 355.		β Capricorni		1863, July 2			h m s 6 22 15·87	G.M.T.
$-3''\cdot78 = -\cdot940\Delta\alpha$	$+\cdot216\Delta\delta$	$+\cdot941\Delta\alpha'$	$-\cdot213\Delta\delta'$	$-\cdot567\Delta T$	$-\cdot558\Delta l$	$-\cdot013\Delta\phi'$	$-2560\cdot6p$	$-1000\cdot5s$
Rot^{n} No. 356.		Washington 9439		1863, Nov. 17			10 10 37·24	G.M.T.
$-1''\cdot38 = -\cdot899\Delta\alpha$	$-\cdot415\Delta\delta$	$+\cdot899\Delta\alpha'$	$+\cdot412\Delta\delta'$	$-\cdot582\Delta T$	$-\cdot585\Delta l$	$+\cdot015\Delta\phi'$	$+1884\cdot2p$	$-967\cdot4s$
Rot^{n} No. 357.		ξ Aquarii		1863, Nov. 17			10 24 57·34	G.M.T.
$+0''\cdot50 = -\cdot985\Delta\alpha$	$-\cdot072\Delta\delta$	$+\cdot985\Delta\alpha'$	$+\cdot070\Delta\delta'$	$-\cdot563\Delta T$	$-\cdot567\Delta l$	$+\cdot011\Delta\phi'$	$+2802\cdot8p$	$-967\cdot4s$
Rot^{n} No. 358.		ψ Ophiuchi		1864, Feb. 29			13 53 42·12	G.M.T.
$-0''\cdot59 = -\cdot916\Delta\alpha$	$+\cdot226\Delta\delta$	$+\cdot906\Delta\alpha'$	$-\cdot219\Delta\delta'$	$-\cdot398\Delta T$	$-\cdot550\Delta l$	$-\cdot009\Delta\phi'$	$+588\cdot4p$	$-941\cdot1s$
Rot^{n} No. 359.		ψ Ophiuchi		1864, Feb. 29			15 16 38·74	G.M.T.
$+0''\cdot50 = +\cdot918\Delta\alpha$	$-\cdot212\Delta\delta$	$-\cdot906\Delta\alpha'$	$+\cdot209\Delta\delta'$	$+\cdot360\Delta T$	$+\cdot551\Delta l$	$+\cdot006\Delta\phi'$	$+639\cdot2p$	$-941\cdot8s$
Rot^{n} No. 360.		α Virginis		1864, March 24			10 18 1·82	G.M.T.
$-0''\cdot02 = -\cdot585\Delta\alpha$	$+\cdot803\Delta\delta$	$+\cdot579\Delta\alpha'$	$-\cdot792\Delta\delta'$	$-\cdot325\Delta T$	$-\cdot423\Delta l$	$-\cdot014\Delta\phi'$	$+422\cdot4p$	$-908\cdot6s$
Rot^{n} No. 361.		α Virginis		1864, March 24			11 37 40·70	G.M.T.
$-0''\cdot79 = +\cdot980\Delta\alpha$	$-\cdot068\Delta\delta$	$-\cdot967\Delta\alpha'$	$+\cdot068\Delta\delta'$	$+\cdot307\Delta T$	$+\cdot508\Delta l$	$+\cdot002\Delta\phi'$	$+98\cdot9p$	$-909\cdot0s$
Rot^{n} No. 362.		ν Scorpii		1864, March 27			15 39 1·89	G.M.T.
$-0''\cdot39 = -\cdot697\Delta\alpha$	$-\cdot673\Delta\delta$	$+\cdot689\Delta\alpha'$	$+\cdot662\Delta\delta'$	$-\cdot234\Delta T$	$-\cdot367\Delta l$	$+\cdot013\Delta\phi'$	$-1265\cdot5p$	$-935\cdot1s$
Rot^{n} No. 364.		ν Scorpii		1864, March 27			16 38 2·72	G.M.T.
$-0''\cdot54 = +\cdot589\Delta\alpha$	$-\cdot781\Delta\delta$	$-\cdot579\Delta\alpha'$	$+\cdot772\Delta\delta'$	$+\cdot249\Delta T$	$+\cdot386\Delta l$	$+\cdot009\Delta\phi'$	$-1755\cdot8p$	$-935\cdot5s$
Rot^{n} No. 365.		e^2 Sagittarii		1864, April 27			10 58 38·13	G.M.T.
$+0''\cdot89 = -\cdot770\Delta\alpha$	$-\cdot593\Delta\delta$	$+\cdot764\Delta\alpha'$	$+\cdot594\Delta\delta'$	$-\cdot447\Delta T$	$-\cdot528\Delta l$	$+\cdot001\Delta\phi'$	$-3257\cdot2p$	$-963\cdot5s$
Rot^{n} No. 366.		e^2 Sagittarii		1864, April 27			11 55 19·69	G.M.T.
$-0''\cdot08 = +\cdot883\Delta\alpha$	$-\cdot384\Delta\delta$	$-\cdot878\Delta\alpha'$	$+\cdot378\Delta\delta'$	$+\cdot405\Delta T$	$+\cdot484\Delta l$	$+\cdot013\Delta\phi'$	$+1792\cdot8p$	$-963\cdot7s$

Digitized by Google

Rotn No. 367. e^2 Sagittarii 1864, July 18 12 h 19 m 58·84 s G.M.T.

$+ 0''.93 = -·718\Delta\alpha - ·660\Delta\delta + ·710\Delta\alpha' + ·650\Delta\delta' - ·409\Delta T - ·538\Delta l + ·014\Delta\phi' + 250·1p - 991·5s$

Rotn No. 368. e^2 Sagittarii 1864, July 18 13 27 23·31 G.M.T.

$- 0''.90 = +·957\Delta\alpha - ·016\Delta\delta - ·947\Delta\alpha' + ·020\Delta\delta' + ·446\Delta T + ·607\Delta l - ·007\Delta\phi' - 2114·4p - 991·8s$

Rotn No. 369. κ Piscium 1864, Dec. 6 6 9 7·95 G.M.T.

$+ 0''.77 = -·962\Delta\alpha - ·274\Delta\delta + ·949\Delta\alpha' + ·270\Delta\delta' - ·390\Delta T - ·588\Delta l + ·007\Delta\phi' + 259·8p - 968·7s$

Rotn No. 370. κ Piscium 1864, Dec. 6 7 25 33·44 G.M.T.

$- 3''.11 = +·753\Delta\alpha + ·658\Delta\delta - ·744\Delta\alpha' - ·651\Delta\delta' + ·417\Delta T + ·548\Delta l - ·014\Delta\phi' + 16·7p - 968·7s$

Rotn No. 371. χ^4 Orionis 1864, Dec. 13 6 50 58·67 G.M.T.

$- 1''.93 = -·942\Delta\alpha + ·013\Delta\delta + ·937\Delta\alpha' - ·020\Delta\delta' - ·462\Delta T - ·551\Delta l - ·009\Delta\phi' - 2534·9p - 933·2s$

Rotn No. 372. χ^4 Orionis 1864, Dec. 13 8 3 10·59 G.M.T.

$-27''.12 = +·930\Delta\alpha + ·161\Delta\delta - ·940\Delta\alpha' - ·161\Delta\delta' - ·390\Delta T - ·539\Delta l + ·004\Delta\phi' + 2439·5p - 932·7s$

Rotn No. 373. h Virginis 1865, March 14 15 17 8·58 G.M.T.

$- 0''.44 = -·903\Delta\alpha + ·401\Delta\delta + ·893\Delta\alpha' - ·397\Delta\delta' - ·344\Delta T - ·492\Delta l - ·001\Delta\phi' + 2131·8p - 885·7s$

Rotn No. 374. λ Virginis 1865, March 15 14 33 22·50 G.M.T.

$+ 1''.62 = -·375\Delta\alpha + ·923\Delta\delta + ·369\Delta\alpha' - ·910\Delta\delta' - ·215\Delta T - ·300\Delta l - ·013\Delta\phi' + 1418·6p - 889·6s$

Rotn No. 375. λ Virginis 1865, March 15 15 34 21·49 G.M.T.

$- 3''.16 = +·845\Delta\alpha + ·498\Delta\delta - ·854\Delta\alpha' - ·489\Delta\delta' + ·492\Delta T + ·359\Delta l - ·011\Delta\phi' + 1903·7p - 889·8s$

Rotn No. 376. ζ^1 Libræ 1865, May 10 12 17 37·65 G.M.T.

$+ 4''.30 = -·802\Delta\alpha + ·549\Delta\delta + ·791\Delta\alpha' - ·542\Delta\delta' - ·304\Delta T - ·471\Delta l - ·006\Delta\phi' + 1415·4p - 900·7s$

Rotn No. 377. ζ^1 Libræ 1865 May 10 13 39 58·66 G.M.T.

$-37''.23 = +·935\Delta\alpha + ·220\Delta\delta - ·926\Delta\alpha' - ·214\Delta\delta' + ·619\Delta T + ·476\Delta l - ·009\Delta\phi' - 1541·0p - 901·1s$

Digitized by Google

Rot^{n} No. 378.	λ Virginis				1865, June 5			h m s 11 19 30·04 G.M.T.	
+ 1″·07 = + ·249Δα	+ ·967Δδ	+ ·251Δα′	− ·956Δδ′	+ ·005ΔT	+ ·005Δl	− ·015Δφ′	+ 805·2p	−894·7s	
Rot^{n} No. 379.	ζ Piscium				1866, May 11			16 37 37·12 G.M.T.	
− 1″·29 = − ·922Δα	− ·374Δδ	+ ·916Δα′	+ ·370Δδ′	− ·522ΔT	− ·618Δl	− ·003Δφ′	−3219·9p	−991·6s	
Rot^{n} No. 380.	B.A.C. 369				1866, May 11			16 38 22·12 G.M.T.	
− 1″·37 = − ·911Δα	− ·377Δδ	+ ·904Δα′	+ ·373Δδ′	− ·515ΔT	− ·612Δl	− ·003Δφ′	−3219·8p	−991·6s	
Rot^{n} No. 381.	o Leonis				1866, May 20			9 13 12·58 G.M.T.	
− 1″·97 = + ·208Δα	+ ·977Δδ	− ·205Δα′	− ·975Δδ′	− ·079ΔT	− ·031Δl	− ·015Δφ′	+1416·6p	−928·6s	
Rot^{n} No. 382.	o Leonis				1866, May 20			9 24 14·78 G.M.T.	
− 6″·00 = + ·529Δα	+ ·843Δδ	− ·525Δα′	− ·843Δδ′	+ ·098ΔT	+ ·159Δl	− ·016Δφ′	+ 229·8p	−928·5s	
Rot^{n} No. 383.	B.A.C. 5579				1866, June 25			11 36 32·94 G.M.T.	
+18″·62 = − ·380Δα	+ ·917Δδ	+ ·373Δα′	− ·907Δδ′	− ·151ΔT	− ·246Δl	− ·011Δφ′	+1656·9p	−888·5s	
Rot^{n} No. 384.	δ^{3} Tauri				1866, July 8			17 6 38·64 G.M.T.	
+ 0″·03 = + ·938Δα	+ ·196Δδ	− ·928Δα′	− ·194Δδ′	+ ·461ΔT	+ ·610Δl	+ ·004Δφ′	+2487·5p	−985·1s	
Rot^{n} No. 385.	Weisse IV. 401				1866, July 8			17 2 33·14 G.M.T.	
+ 2″·44 = − ·475Δα	− ·868Δδ	+ ·472Δα′	+ ·860Δδ′	− ·332ΔT	− ·370Δl	+ ·007Δφ′	−3267·7p	−985·1s	
Rot^{n} No. 386.	e^{2} Sagittarii				1866, July 26			4 34 16·99 G.M.T.	
− 0″·07 = − ·949Δα	+ ·125Δδ	+ ·948Δα′	− ·119Δδ′	− ·492ΔT	− ·510Δl	− ·011Δφ′	−2510·9p	−912·6s	
Rot^{n} No. 387.	e^{2} Sagittarii				1866, July 26			5 39 14·75 G.M.T.	
− 7″·52 = + ·956Δα	− ·040Δδ	− ·951Δα′	+ ·037Δδ′	+ ·440ΔT	+ ·519Δl	+ ·009Δφ′	+2489·4p	−913·0s	
Rot^{n} No. 388.	o Piscium				1866, Aug. 29			8 57 28·60 G.M.T.	
+ 2″·61 = − ·814Δα	− ·571Δδ	+ ·211Δα′	+ ·567Δδ′	− ·533ΔT	− ·564Δl	+ ·000Δφ′	−3518·4p	−971·0s	

Digitized by Google

Rot^{n} No. 389. *o* Piscium 1866, Aug. 29 h m s 9 58 0·08 G.M.T.

$-2''\cdot16 = +\cdot976\Delta\alpha + \cdot169\Delta\delta - \cdot969\Delta\alpha' - \cdot167\Delta\delta' + \cdot484\Delta T + \cdot590\Delta l + \cdot006\Delta\phi' + 2859\cdot4p - 971\cdot18$

Rot^{n} No. 390. ϕ Ophiuchi 1866, Sept. 15 5 24 33·22 G.M.T.

$+1''\cdot00 = -\cdot569\Delta\alpha - \cdot804\Delta\delta + \cdot564\Delta\alpha' + \cdot793\Delta\delta' - \cdot160\Delta T - \cdot243\Delta l + \cdot014\Delta\phi' - 95\cdot0p - 886\cdot58$

Rot^{n} No. 391. ϕ Ophiuchi 1866, Sept. 15 6 11 30·54 G.M.T.

$-0''\cdot76 = +\cdot424\Delta\alpha - \cdot897\Delta\delta - \cdot417\Delta\alpha' + \cdot887\Delta\delta' + \cdot172\Delta T + \cdot270\Delta l + \cdot011\Delta\phi' - 1796\cdot7p - 886\cdot68$

Rot^{n} No. 392. θ Aquarii 1867, Jan. 9 6 34 26·20 G.M.T.

$-0''\cdot35 = -\cdot973\Delta\alpha - \cdot174\Delta\delta + \cdot969\Delta\alpha' + \cdot172\Delta\delta' - \cdot473\Delta T - \cdot526\Delta l + \cdot011\Delta\phi' + 2335\cdot5p - 915\cdot88$

Rot^{n} No. 393. ϕ Ophiuchi 1867, Jan. 29 13 8 50·04 G.M.T.

$+0''\cdot32 = +\cdot437\Delta\alpha + \cdot890\Delta\delta - \cdot432\Delta\alpha' - \cdot888\Delta\delta' + \cdot099\Delta T + \cdot160\Delta l - \cdot008\Delta\phi' + 2647\cdot6p - 885\cdot28$

Rot^{n} No. 394. η Virginis 1867, April 16 11 49 13·14 G.M.T.

$+2''\cdot42 = -\cdot973\Delta\alpha - \cdot230\Delta\delta + \cdot963\Delta\alpha' + \cdot228\Delta\delta' - \cdot300\Delta T - \cdot459\Delta l + \cdot009\Delta\phi' + 1219\cdot7p - 923\cdot28$

Rot^{n} No. 396. η Virginis 1867, April 16 12 49 28·11 G.M.T.

$-5''\cdot19 = +\cdot462\Delta\alpha - \cdot887\Delta\delta - \cdot458\Delta\alpha' + \cdot879\Delta\delta' + \cdot328\Delta T + \cdot386\Delta l + \cdot009\Delta\phi' - 2695\cdot7p - 922\cdot98$

Rot^{n} No. 397. τ^{2} Capricorni 1867, Oct. 7 7 31 8·31 G.M.T.

$+3''\cdot73 = -\cdot820\Delta\alpha + \cdot524\Delta\delta + \cdot809\Delta\alpha' - \cdot517\Delta\delta' - \cdot205\Delta T - \cdot374\Delta l - \cdot005\Delta\phi' - 203\cdot2p - 893\cdot38$

Rot^{n} No. 399. Lal. 39819 1867, Oct. 7 7 54 28·31 G.M.T.

$+4''\cdot71 = -\cdot604\Delta\alpha + \cdot779\Delta\delta + \cdot595\Delta\alpha' - \cdot769\Delta\delta' - \cdot110\Delta T - \cdot241\Delta l - \cdot009\Delta\phi' + 1576\cdot9p - 893\cdot48$

Rot^{n} No. 400. τ^{2} Capricorni 1867, Oct. 7 8 27 52·51 G.M.T.

$-6''\cdot63 = +\cdot337\Delta\alpha + \cdot937\Delta\delta - \cdot335\Delta\alpha' - \cdot924\Delta\delta' + \cdot224\Delta T + \cdot256\Delta l - \cdot015\Delta\phi' + 548\cdot1p - 893\cdot58$

Rot^{n} No. 402. τ^{2} Capricorni 1867, Dec. 28 6 47 30·10 G.M.T.

$+2''\cdot70 = -\cdot385\Delta\alpha - \cdot916\Delta\delta + \cdot388\Delta\alpha' + \cdot913\Delta\delta' - \cdot319\Delta T - \cdot273\Delta l + \cdot015\Delta\phi' + 489\cdot2p - 883\cdot08$

Digitized by Google

Rotn No. 403. Lal. 39819 1867, Dec. 28 h m s 6 49 58·09 G.M.T.

+ 7″·03 = −·568Δα −·806Δδ +·571Δα′ +·803Δδ′ −·397ΔT −·355Δl +·015Δφ′ + 205·7p −883·0s

Rotn No. 404. ν Leonis 1868, Feb. 8 7 44 23·26 G.M.T.

−14″·65 = +·798Δα −·578Δδ −·789Δα′ +·576Δδ′ −·536ΔT −·408Δl +·014Δφ′ + 656·0p −998·8s

Rotn No. 405. χ Leonis 1868, April 4 7 28 21·88 G.M.T.

+ 3″·50 = −·740Δα +·666Δδ +·729Δα′ −·659Δδ′ −·389ΔT −·547Δl −·011Δφ′ + 791·5p −974·9s

Rotn No. 406. ξ¹ Ceti 1868, Aug. 9 16 37 36·22 G.M.T.

+ 7″·41 = −·991Δα +·015Δδ +·978Δα′ −·015Δδ′ −·302ΔT −·498Δl +·002Δφ′ + 771·0p −915·6s

Rotn No. 407. χ⁴ Orionis 1868, Dec. 28 10 35 4·11 G.M.T.

+ 0″·84 = −·396Δα +·907Δδ +·391Δα′ −·898Δδ′ −·132ΔT −·214Δl −·009Δφ′ +2734·6p −972·3s

Rotn No. 408. ζ Geminorum 1868, Dec. 29 8 55 55·01 G.M.T.

+ 0″·68 = −·904Δα −·275Δδ +·893Δα′ +·269Δδ′ −·418ΔT −·582Δl −·002Δφ′ −2314·1p −980·8s

Rotn No. 409. δ Cancri 1869, March 23 9 14 59·43 G.M.T.

+ 0″·64 = −·774Δα −·583Δδ +·763Δα′ +·579Δδ′ −·254ΔT −·424Δl +·010Δφ′ − 403·5p −978·9s

Rotn No. 411. δ Cancri 1869, March 23 9 58 37·64 G.M.T.

− 0″·56 = +·282Δα −·955Δδ −·281Δα′ +·947Δδ′ +·265ΔT +·273Δl +·009Δφ′ −3073·2p −979·2s

Rotn No. 413. φ Ophiuchi 1869, May 25 5 58 40·59 G.M.T.

+ 3″·79 = −·939Δα −·194Δδ +·935Δα′ +·198Δδ′ −·465ΔT −·533Δl −·006Δφ′ −3080·1p −956·9s

Rotn No. 415. π Capricorni 1869, Aug. 19 13 17 10·31 G.M.T.

+30″·06 = −·928Δα −·190Δδ +·923Δα′ +·185Δδ′ −·429ΔT −·514Δl +·010Δφ′ +2119·6p −902·0s

Rotn No. 416. ρ Capricorni 1869, Aug. 19 14 43 6·79 G.M.T.

− 1″·78 = +·136Δα −·990Δδ −·131Δα′ +·986Δδ′ −·066ΔT −·001Δl +·012Δφ′ −1991·6p −901·6s

Digitized by Google

Rot^{n} No. 417.			ρ Capricorni			1869, Aug. 19	h m s 14 51 45·79 G.M.T.	
$-4''\cdot74 =$	$+\cdot398\Delta\alpha$	$-\cdot907\Delta\delta$	$-\cdot394\Delta\alpha'$	$+\cdot906\Delta\delta'$	$+\cdot081\Delta T$	$+\cdot146\Delta l$	$+\cdot008\Delta\phi'$	$-2648\cdot7p - 901\cdot68$
Rot^{n} No. 418.			δ^{1} Tauri			1869, Aug. 29	15 7 51·87 G.M.T.	
$+4''\cdot31 =$	$-\cdot927\Delta\alpha$	$-\cdot255\Delta\delta$	$+\cdot915\Delta\alpha'$	$+\cdot250\Delta\delta'$	$-\cdot341\Delta T$	$-\cdot520\Delta l$	$-\cdot000\Delta\phi'$	$-1564\cdot9p - 911\cdot68$
Rot^{n} No. 420.			δ^{1} Tauri			1869, Aug. 29	16 38 29·06 G.M.T.	
$-4''\cdot55 =$	$+\cdot843\Delta\alpha$	$+\cdot476\Delta\delta$	$-\cdot831\Delta\alpha'$	$-\cdot472\Delta\delta'$	$+\cdot323\Delta T$	$+\cdot502\Delta l$	$-\cdot005\Delta\phi'$	$+1125\cdot1p - 912\cdot48$
Rot^{n} No. 422.			δ^{2} Tauri			1869, Aug. 29	17 19 40·95 G.M.T.	
$+0''\cdot06 =$	$-\cdot610\Delta\alpha$	$-\cdot771\Delta\delta$	$+\cdot601\Delta\alpha'$	$+\cdot763\Delta\delta'$	$-\cdot274\Delta T$	$-\cdot411\Delta l$	$+\cdot009\Delta\phi'$	$-1619\cdot6p - 912\cdot78$
Rot^{n} No. 423.			ξ^{1} Ceti			1869, Oct. 20	11 13 34·04 G.M.T.	
$+1''\cdot62 =$	$-\cdot641\Delta\alpha$	$-\cdot763\Delta\delta$	$+\cdot632\Delta\alpha'$	$+\cdot754\Delta\delta'$	$-\cdot305\Delta T$	$-\cdot433\Delta l$	$+\cdot009\Delta\phi'$	$-1513\cdot8p - 887\cdot98$
Rot^{n} No. 424.			ξ^{1} Ceti			1869, Oct. 20	12 39 39·57 G.M.T.	
$-3''\cdot96 =$	$+\cdot976\Delta\alpha$	$+\cdot176\Delta\delta$	$-\cdot964\Delta\alpha'$	$-\cdot175\Delta\delta'$	$+\cdot317\Delta T$	$+\cdot493\Delta l$	$-\cdot006\Delta\phi'$	$-803\cdot7p - 888\cdot18$
Rot^{n} No. 425.			B.A.C. 5579			1870, Feb. 22	15 30 15·85 G.M.T.	
$+6''\cdot25 =$	$-\cdot761\Delta\alpha$	$-\cdot600\Delta\delta$	$+\cdot750\Delta\alpha'$	$+\cdot593\Delta\delta'$	$-\cdot206\Delta T$	$-\cdot376\Delta l$	$+\cdot007\Delta\phi'$	$-1606\cdot5p - 954\cdot98$
Rot^{n} No. 426.			B.A.C. 5579			1870, Feb. 22	16 14 28·66 G.M.T.	
$-3''\cdot10 =$	$+\cdot194\Delta\alpha$	$-\cdot979\Delta\delta$	$-\cdot192\Delta\alpha'$	$+\cdot963\Delta\delta'$	$+\cdot202\Delta T$	$+\cdot229\Delta l$	$+\cdot016\Delta\phi'$	$-843\cdot8p - 954\cdot68$
Rot^{n} No. 428.			ξ Tauri			1870, March 10	7 47 5·26 G.M.T.	
$+5''\cdot48 =$	$-\cdot904\Delta\alpha$	$+\cdot264\Delta\delta$	$+\cdot895\Delta\alpha'$	$-\cdot261\Delta\delta'$	$-\cdot345\Delta T$	$-\cdot481\Delta l$	$+\cdot003\Delta\phi'$	$+2413\cdot4p - 911\cdot09$
Rot^{n} No. 430.			ξ Tauri			1870, March 10	9 3 8·20 G.M.T.	
$-27''\cdot52 =$	$+\cdot894\Delta\alpha$	$+\cdot298\Delta\delta$	$-\cdot887\Delta\alpha'$	$-\cdot302\Delta\delta'$	$+\cdot397\Delta T$	$+\cdot512\Delta l$	$-\cdot011\Delta\phi'$	$-1618\cdot9p - 911\cdot68$
Rot^{n} No. 431.			c Virginis			1870, March 17	9 23 46·50 G.M.T.	
$-6''\cdot05 =$	$+\cdot776\Delta\alpha$	$+\cdot630\Delta\delta$	$-\cdot766\Delta\alpha'$	$-\cdot622\Delta\delta'$	$+\cdot165\Delta T$	$+\cdot313\Delta l$	$-\cdot005\Delta\phi'$	$+2536\cdot9p - 1000\cdot48$

Digitized by Google

Rotn No. 433. μ^1 Sagittarii 1870, March 23 11 36 34·65 G.M.T.

$+ 0''.73 = -\cdot229\Delta\alpha + \cdot969\Delta\delta + \cdot233\Delta\alpha' - \cdot962\Delta\delta' - \cdot240\Delta T - \cdot180\Delta l - \cdot016\Delta\phi' + 816\cdot5p - 947\cdot1s$

Rotn No. 434. μ^1 Sagittarii 1870, March 23 12 5 0·68 G.M.T.

$- 4''.38 = +\cdot608\Delta\alpha + \cdot758\Delta\delta - \cdot602\Delta\alpha' - \cdot754\Delta\delta' + \cdot235\Delta T + \cdot334\Delta l - \cdot005\Delta\phi' + 2870\cdot6p - 946\cdot9s$

Rotn No. 435. 15 Sagittarii 1870, March 23 11 56 34·66 G.M.T.

$+ 4''.54 = -\cdot853\Delta\alpha - \cdot402\Delta\delta + \cdot848\Delta\alpha' + \cdot405\Delta\delta' - \cdot411\Delta T - \cdot497\Delta l - \cdot003\Delta\phi' - 3131\cdot6p - 946\cdot9s$

Rotn No. 436. 15 Sagittarii 1870, March 23 12 48 33·21 G.M.T.

$- 5''.00 = +\cdot612\Delta\alpha - \cdot754\Delta\delta - \cdot610\Delta\alpha' + \cdot745\Delta\delta' + \cdot377\Delta T + \cdot398\Delta l + \cdot016\Delta\phi' + 675\cdot0p - 946\cdot5s$

Rotn No. 437. δ Capricorni 1870, Sept. 7 10 6 49·92 G.M.T.

$+ 5''.08 = -\cdot955\Delta\alpha - \cdot060\Delta\delta + \cdot941\Delta\alpha' + \cdot059\Delta\delta' - \cdot328\Delta T - \cdot528\Delta l + \cdot003\Delta\phi' + 521\cdot8p - 922\cdot2s$

Rotn No. 438. δ Capricorni 1870, Sept. 7 11 24 25·42 G.M.T.

$- 4''.94 = +\cdot642\Delta\alpha + \cdot742\Delta\delta - \cdot635\Delta\alpha' - \cdot730\Delta\delta' + \cdot357\Delta T + \cdot452\Delta l - \cdot015\Delta\phi' - 164\cdot8p - 921\cdot7s$

Rotn No. 439. γ Libræ 1870, Sept. 28 6 4 21·46 G.M.T.

$+ 3''.85 = -\cdot782\Delta\alpha - \cdot588\Delta\delta + \cdot779\Delta\alpha' + \cdot581\Delta\delta' - \cdot321\Delta T - \cdot367\Delta l + \cdot016\Delta\phi' + 3158\cdot6p - 986\cdot7s$

Rotn No. 440. γ Libræ 1870, Sept. 28 6 44 43·45 G.M.T.

$- 7''.77 = +\cdot429\Delta\alpha - \cdot896\Delta\delta - \cdot425\Delta\alpha' + \cdot892\Delta\delta' + \cdot348\Delta T + \cdot421\Delta l + \cdot009\Delta\phi' - 2851\cdot9p - 986\cdot4s$

Rotn No. 441. ξ^1 Ceti 1870, Oct. 10 8 13 36·94 G.M.T.

$+ 3''.87 = -\cdot469\Delta\alpha - \cdot881\Delta\delta + \cdot466\Delta\alpha' + \cdot874\Delta\delta' - \cdot339\Delta T - \cdot378\Delta l + \cdot008\Delta\phi' - 2772\cdot3p - 885\cdot1s$

Rotn No. 442. ξ^1 Ceti 1870, Oct. 10 9 23 41·12 G.M.T.

$-22''.77 = +\cdot989\Delta\alpha + \cdot071\Delta\delta - \cdot978\Delta\alpha' - \cdot070\Delta\delta' + \cdot309\Delta T + \cdot473\Delta l + \cdot006\Delta\phi' + 1608\cdot0p - 884\cdot9s$

Rotn No. 443. ψ^1 Aquarii 1870, Dec. 27 8 20 42·09 G.M.T.

$+ 6''.73 = -\cdot761\Delta\alpha - \cdot634\Delta\delta + \cdot759\Delta\alpha' + \cdot629\Delta\delta' - \cdot478\Delta T - \cdot505\Delta l + \cdot016\Delta\phi' + 995\cdot6p - 921\cdot9s$

Digitized by Google

Rot^{n} No. 445.	ψ^{2} Aquarii					1870, Dec. 27	h m s 9 29 27·24 G.M.T.		
$+ 3''\cdot28 = -\cdot658\Delta\alpha$	$+\cdot744\Delta\delta$	$+\cdot656\Delta\alpha'$	$-\cdot744\Delta\delta'$	$-\cdot165\Delta T$	$-\cdot193\Delta l$	$-\cdot004\Delta\phi'$	$+3243\cdot6p$	$-\ 921\cdot2s$	
Rot^{n} No. 446.	1 Geminorum					1871, Feb. 1	7 9 9·65 G.M.T.		
$+ 4''\cdot65 = -\cdot901\Delta\alpha$	$-\cdot219\Delta\delta$	$+\cdot914\Delta\alpha'$	$+\cdot222\Delta\delta'$	$-\cdot695\Delta T$	$-\cdot502\Delta l$	$+\cdot002\Delta\phi'$	$-1141\cdot5p$	$-\ 896\cdot5s$	
Rot^{n} No. 448.	1 Geminorum					1871, Feb. 1	8 45 19·02 G.M.T.		
$-\ 5''\cdot76 = +\cdot920\Delta\alpha$	$+\cdot090\Delta\delta$	$-\cdot907\Delta\alpha'$	$-\cdot092\Delta\delta'$	$+\cdot312\Delta T$	$+\cdot508\Delta l$	$-\cdot003\Delta\phi'$	$-\ 328\cdot2p$	$-\ 897\cdot0s$	
Rot^{n} No. 449.	θ Libræ					1871, May 5	7 54 11·16 G.M.T.		
$-32''\cdot59 = -\cdot939\Delta\alpha$	$+\cdot199\Delta\delta$	$+\cdot932\Delta\alpha'$	$-\cdot192\Delta\delta'$	$-\cdot520\Delta T$	$-\cdot630\Delta l$	$-\cdot011\Delta\phi'$	$-2204\cdot0p$	$-1000\cdot9s$	
Rot^{n} No. 450.	θ Libræ					1871, May 5	8 57 58·35 G.M.T.		
$-\ 4''\cdot96 = +\cdot699\Delta\alpha$	$-\cdot682\Delta\delta$	$-\cdot693\Delta\alpha'$	$+\cdot672\Delta\delta'$	$+\cdot470\Delta T$	$+\cdot568\Delta l$	$+\cdot016\Delta\phi'$	$+\ 559\cdot8p$	$-1000\cdot9s$	
Rot^{n} No. 451.	θ Libræ					1871, June 29	5 9 34·35 G.M.T.		
$+ 4''\cdot07 = -\cdot957\Delta\alpha$	$-\cdot029\Delta\delta$	$+\cdot947\Delta\alpha'$	$+\cdot034\Delta\delta'$	$-\cdot424\Delta T$	$-\cdot585\Delta l$	$-\cdot006\Delta\phi'$	$-2119\cdot3p$	$-\ 991\cdot4s$	
Rot^{n} No. 452.	θ Libræ					1871, June 29	6 11 21·48 G.M.T.		
$-11''\cdot06 = -\cdot520\Delta\alpha$	$-\cdot839\Delta\delta$	$+\cdot512\Delta\alpha'$	$+\cdot827\Delta\delta'$	$-\cdot039\Delta T$	$-\cdot168\Delta l$	$+\cdot011\Delta\phi'$	$-1764\cdot2p$	$-\ 991\cdot8s$	
Rot^{n} No. 453.	σ Scorpii					1875, Aug. 10	8 35 20·63 G.M.T.		
$+ 3''\cdot98 = -\cdot838\Delta\alpha$	$-\cdot369\Delta\delta$	$+\cdot831\Delta\alpha'$	$+\cdot362\Delta\delta'$	$-\cdot294\Delta T$	$-\cdot407\Delta l$	$+\cdot011\Delta\phi'$	$+1421\cdot5p$	$-\ 887\cdot6s$	
Rot^{n} No. 454.	ι Geminorum					1876, March 5	6 40 24·13 G.M.T.		
$+ 5''\cdot61 = -\cdot703\Delta\alpha$	$+\cdot612\Delta\delta$	$+\cdot691\Delta\alpha'$	$-\cdot609\Delta\delta'$	$-\cdot346\Delta T$	$-\cdot522\Delta l$	$-\cdot006\Delta\phi'$	$+1631\cdot3p$	$-\ 971\cdot9s$	
Rot^{n} No. 455.	17 Tauri					1879, Oct. 31	7 31 23·06 G.M.T.		
$-\ 3''\cdot00 = -\cdot789\Delta\alpha$	$+\cdot512\Delta\delta$	$+\cdot782\Delta\alpha'$	$-\cdot516\Delta\delta'$	$-\cdot258\Delta T$	$-\cdot369\Delta l$	$-\cdot012\Delta\phi'$	$-\ 955\cdot1p$	$-\ 882\cdot6s$	
Rot^{n} No. 457.	20 Tauri					1879, Oct. 31	8 0 10·12 G.M.T.		
$+ 2''\cdot82 = -\cdot895\Delta\alpha$	$-\cdot227\Delta\delta$	$+\cdot889\Delta\alpha'$	$+\cdot220\Delta\delta'$	$-\cdot403\Delta T$	$-\cdot493\Delta l$	$-\cdot005\Delta\phi'$	$-2679\cdot4p$	$-\ 882\cdot6s$	

Digitized by Google

Rotn No. 459. 16 Tauri 1879, Oct. 31 h m s 8 37 6·79 G.M.T.

$-6''\cdot05 = +\cdot804\Delta\alpha + \cdot482\Delta\delta - \cdot798\Delta\alpha' - \cdot478\Delta\delta' + \cdot380\Delta T + \cdot468\Delta l + \cdot001\Delta\phi' + 2868\cdot1p - 882\cdot6s$

Rotn No. 460. 19 Tauri 1879, Oct. 31 8 57 58·53 G.M.T.

$-6''\cdot41 = +\cdot917\Delta\alpha - \cdot038\Delta\delta - \cdot907\Delta\alpha' + \cdot039\Delta\delta' + \cdot334\Delta T + \cdot481\Delta l + \cdot006\Delta\phi' + 815\cdot2p - 882\cdot6s$

Rotn No. 461. 20 Tauri 1879, Oct. 31 9 16 40·72 G.M.T.

$-6''\cdot71 = +\cdot779\Delta\alpha + \cdot529\Delta\delta - \cdot772\Delta\alpha' - \cdot524\Delta\delta' + \cdot351\Delta T - \cdot457\Delta l - \cdot000\Delta\phi' + 2706\cdot5p - 882\cdot6s$

Rotn No. 463. 15 Arietis 1880, Jan. 19 8 41 36·24 G.M.T.

$+16''\cdot72 = -\cdot187\Delta\alpha - \cdot981\Delta\delta + \cdot183\Delta\alpha' + \cdot977\Delta\delta' - \cdot170\Delta T - \cdot244\Delta l + \cdot012\Delta\phi' - 1721\cdot5p - 890\cdot9s$

Rotn No. 464. θ Ophiuchi 1880, Feb. 5 13 45 48·74 G.M.T.

$+14''\cdot71 = -\cdot904\Delta\alpha - \cdot015\Delta\delta + \cdot901\Delta\alpha' + \cdot023\Delta\delta' - \cdot551\Delta T - \cdot598\Delta l - \cdot009\Delta\phi' - 2941\cdot5p - 974\cdot8s$

Rotn No. 466. θ Ophiuchi 1880, Feb. 5 14 45 49·01 G.M.T.

$-12''\cdot23 = +\cdot855\Delta\alpha - \cdot327\Delta\delta - \cdot850\Delta\alpha' + \cdot320\Delta\delta' + \cdot497\Delta T + \cdot565\Delta l + \cdot013\Delta\phi' + 2107\cdot6p - 974\cdot8s$

Rotn No. 467. χ^1 Tauri 1880, Feb. 18 6 58 16·70 G.M.T.

$+4''\cdot58 = -\cdot882\Delta\alpha - \cdot247\Delta\delta + \cdot870\Delta\alpha' + \cdot246\Delta\delta' - \cdot309\Delta T - \cdot488\Delta l + \cdot006\Delta\phi' + 544\cdot1p - 887\cdot0s$

Rotn No. 468. 26 Ophiuchi 1880, March 3 11 47 59·91 G.M.T.

$-8''\cdot28 = +\cdot611\Delta\alpha + \cdot738\Delta\delta - \cdot605\Delta\alpha' - \cdot736\Delta\delta' + \cdot277\Delta T + \cdot378\Delta l - \cdot004\Delta\phi' + 3016\cdot9p - 968\cdot6s$

Rotn No. 469. 7 Sagittarii 1880, March 4 12 4 48·04 G.M.T.

$-13''\cdot30 = +\cdot901\Delta\alpha - \cdot126\Delta\delta - \cdot900\Delta\alpha' + \cdot121\Delta\delta' + \cdot576\Delta T + \cdot575\Delta l + \cdot011\Delta\phi' + 2706\cdot6p - 966\cdot4s$

Rotn No. 471. 9 Sagittarii 1880, March 4 12 29 40·28 G.M.T.

$-16''\cdot06 = +\cdot903\Delta\alpha + \cdot108\Delta\delta - \cdot900\Delta\alpha' - \cdot111\Delta\delta' + \cdot541\Delta T + \cdot586\Delta l + \cdot008\Delta\phi' + 3059\cdot1p - 966\cdot3s$

Rotn No. 471. O. Arg. 17540 1880, March 4 12 31 36·96 G.M.T.

$-13\cdot85 = +\cdot906\Delta\alpha - \cdot072\Delta\delta - \cdot903\Delta\alpha' + \cdot067\Delta\delta' + \cdot547\Delta T + \cdot580\Delta l + \cdot010\Delta\phi' + 2783\cdot1p - 966\cdot3s$

Digitized by Google

Rot^{n} No. 472. d^{1} Cancri 1880, March 21 h m s 6 0 7·01 G.M.T.

$+ 9''\cdot55 = -\cdot835\Delta\alpha + \cdot477\Delta\delta + \cdot823\Delta\alpha' - \cdot475\Delta\delta' - \cdot333\Delta T - \cdot512\Delta l - \cdot007\Delta\phi' + 581\cdot7p - 911\cdot08$

Rot^{n} No. 473. B.A.C. 5641 1880, March 30 16 7 5·55 G.M.T.

$-14''\cdot30 = +\cdot875\Delta\alpha + \cdot268\Delta\delta - \cdot862\Delta\alpha' - \cdot260\Delta\delta' + \cdot380\Delta T + \cdot571\Delta l - \cdot007\Delta\phi' - 727\cdot8p - 977\cdot58$

Rot^{n} No. 474. ν^{2} Sagittarii 1880, April 1 14 41 19·39 G.M.T.

$-13''\cdot28 = +\cdot910\Delta\alpha + \cdot151\Delta\delta - \cdot898\Delta\alpha' - \cdot150\Delta\delta' + \cdot398\Delta T + \cdot584\Delta l + \cdot003\Delta\phi' + 1688\cdot3p - 964\cdot98$

Rot^{n} No. 475. f Sagittarii 1880, April 2 11 6 18·33 G.M.T.

$-14''\cdot22 = +\cdot913\Delta\alpha + \cdot224\Delta\delta - \cdot914\Delta\alpha' - \cdot227\Delta\delta' - \cdot588\Delta T - \cdot576\Delta l + \cdot006\Delta\phi' + 3261\cdot9p - 958\cdot18$

Rot^{n} No. 476. 19 Scorpii 1880, April 26 12 19 11·24 G.M.T.

$-13''\cdot42 = +\cdot892\Delta\alpha + \cdot217\Delta\delta - \cdot877\Delta\alpha' - \cdot212\Delta\delta' + \cdot376\Delta T + \cdot593\Delta l - \cdot003\Delta\phi' + 379\cdot7p - 994\cdot78$

Rot^{n} No. 477. 39 Ophiuchi 1880, April 27 8 6 27·43 G.M.T.

$-12''\cdot45 = +\cdot894\Delta\alpha + \cdot182\Delta\delta - \cdot890\Delta\alpha' - \cdot186\Delta\delta' + \cdot560\Delta T + \cdot608\Delta l + \cdot007\Delta\phi' + 3241\cdot8p - 991\cdot08$

Rot^{n} No. 478. 4 Sagittarii 1880, May 25 8 27 3·44 G.M.T.

$+ 8''\cdot68 = -\cdot796\Delta\alpha - \cdot487\Delta\delta + \cdot787\Delta\alpha' + \cdot488\Delta\delta' - \cdot434\Delta T - \cdot571\Delta l + \cdot000\Delta\phi' - 2881\cdot6p - 1000\cdot28$

Rot^{n} No. 479. 4 Sagittarii 1880, May 25 9 24 43·60 G.M.T.

$-10''\cdot57 = +\cdot755\Delta\alpha - \cdot560\Delta\delta - \cdot749\Delta\alpha' + \cdot550\Delta\delta' + \cdot399\Delta T + \cdot495\Delta l + \cdot015\Delta\phi' + 1224\cdot8p - 999\cdot98$

Rot^{n} No. 480. o Sagittarii 1880, May 26 8 18 25·43 G.M.T.

$+13''\cdot37 = -\cdot918\Delta\alpha - \cdot120\Delta\delta + \cdot914\Delta\alpha' + \cdot127\Delta\delta' - \cdot557\Delta T - \cdot618\Delta l - \cdot008\Delta\phi' - 3120\cdot8p - 992\cdot28$

Rot^{n} No. 481. B.A.C. 3398 1880, June 13 5 2 2·22 G.M.T.

$- 0''\cdot12 = -\cdot756\Delta\alpha - \cdot645\Delta\delta + \cdot746\Delta\alpha' + \cdot639\Delta\delta' - \cdot088\Delta T - \cdot234\Delta l + \cdot011\Delta\phi' - \cdot414\cdot9p - 908\cdot88$

Rot^{n} No. 482. W.B. IX. 1068 1880, June 13 5 39 22·30 G.M.T.

$+ 0''\cdot38 = -\cdot986\Delta\alpha + \cdot079\Delta\delta + \cdot975\Delta\alpha' - \cdot077\Delta\delta' - \cdot334\Delta T - \cdot492\Delta l + \cdot005\Delta\phi' - 1867\cdot1p - 909\cdot28$

Digitized by Google

Rot^{n} No. 483. B.A.C. 3407 1880, June 13 6 19 45·96 G.M.T.

$+ 9''\cdot14 = -\cdot766\Delta\alpha + \cdot633\Delta\delta + \cdot760\Delta\alpha' - \cdot628\Delta\delta' - \cdot408\Delta T - \cdot498\Delta l - \cdot003\Delta\phi' + 2930\cdot4p - 909\cdot3s$

Rot^{n} No. 484. B.A.C. 3407 1880, June 13 7 29 31·06 G.M.T.

$-14''\cdot11 = +\cdot896\Delta\alpha - \cdot425\Delta\delta - \cdot891\Delta\alpha' + \cdot421\Delta\delta' + \cdot454\Delta T + \cdot519\Delta l - \cdot002\Delta\phi' - 3132\cdot9p - 909\cdot8s$

Rot^{n} No. 485. W.B. IX. 1110 1880, June 13 7 17 26·85 G.M.T.

$- 3''\cdot96 = -\cdot681\Delta\alpha - \cdot725\Delta\delta + \cdot676\Delta\alpha' + \cdot723\Delta\delta' - \cdot096\Delta T - \cdot180\Delta l + \cdot015\Delta\phi' + 206\cdot3p - 909\cdot7s$

Rot^{n} No. 486. π Leonis 1880, June 13 7 39 12·10 G.M.T.

$- 5''\cdot57 = -\cdot871\Delta\alpha + \cdot476\Delta\delta + \cdot867\Delta\alpha' - \cdot473\Delta\delta' - \cdot462\Delta T - \cdot517\Delta l + \cdot001\Delta\phi' + 3196\cdot2p - 909\cdot9s$

Rot^{n} No. 487. 34 Sextantis 1880, June 14 4 30 13·12 G.M.T.

$+ 6''\cdot15 = -\cdot866\Delta\alpha + \cdot496\Delta\delta + \cdot855\Delta\alpha' - \cdot490\Delta\delta' - \cdot355\Delta T - \cdot528\Delta l - \cdot005\Delta\phi' + 1459\cdot9p - 919\cdot4s$

Rot^{n} No. 488. B.A.C. 4722 1880, June 18 9 25 56·91 G.M.T.

$+ 8''\cdot08 = -\cdot951\Delta\alpha - \cdot014\Delta\delta + \cdot939\Delta\alpha' + \cdot013\Delta\delta' - \cdot396\Delta T - \cdot573\Delta l + \cdot006\Delta\phi' + 1704\cdot8p - 978\cdot2s$

Rot^{n} No. 489. 19 Scorpii 1880, June 20 8 39 33·77 G.M.T.

$+ 12''\cdot82 = -\cdot777\Delta\alpha + \cdot527\Delta\delta + \cdot765\Delta\alpha' - \cdot516\Delta\delta' - \cdot383\Delta T - \cdot566\Delta l - \cdot010\Delta\phi' + 80\cdot8p - 999\cdot0s$

Rot^{n} No. 490. 39 Ophiuchi 1880, June 21 4 3 48·57 G.M.T.

$+ 12''\cdot64 = -\cdot872\Delta\alpha + \cdot283\Delta\delta + \cdot873\Delta\alpha' - \cdot274\Delta\delta' - \cdot628\Delta T - \cdot610\Delta l - \cdot013\Delta\phi' - 2435\cdot2p - 1002\cdot8s$

Rot^{n} No. 491. e^{1} Capricorni 1880, June 25 14 9 41·38 G.M.T.

$+ 14''\cdot11 = -\cdot971\Delta\alpha - \cdot164\Delta\delta + \cdot957\Delta\alpha' + \cdot162\Delta\delta' - \cdot362\Delta T - \cdot574\Delta l + \cdot003\Delta\phi' - 197\cdot3p - 967\cdot8s$

Rot^{n} No. 492. e^{1} Capricorni 1880, June 25 15 21 35·29 G.M.T.

$- 10''\cdot54 = +\cdot499\Delta\alpha + \cdot863\Delta\delta - \cdot492\Delta\alpha' - \cdot850\Delta\delta' + \cdot377\Delta T + \cdot471\Delta l - \cdot015\Delta\phi' + 788\cdot8p - 967\cdot1s$

Rot^{n} No. 493. 4 Arietis 1880, June 30 14 12 52·40 G.M.T.

$- 6''\cdot83 = +\cdot895\Delta\alpha - \cdot370\Delta\delta - \cdot886\Delta\alpha' + \cdot370\Delta\delta' + \cdot259\Delta T + \cdot384\Delta l + \cdot011\Delta\phi' + 1244\cdot3p - 900\cdot1s$

Digitized by Google

Rot^{n} No. 494. 4 Sagittarii 1880, July 19 h m s 6 46 31·90 G.M.T.

$-12''\cdot52 = +\cdot705\Delta\alpha \; -\cdot635\Delta\delta \; -\cdot697\Delta\alpha' \; +\cdot624\Delta\delta' \; +\cdot331\Delta T \; +\cdot450\Delta l \; +\cdot015\Delta\phi' \; +672\cdot1p \; -995\cdot0s$

Rot^{n} No. 495. B.A.C. 6161 1880, July 19 12 3 5·64 G.M.T.

$+12''\cdot86 = -\cdot856\Delta\alpha \; +\cdot351\Delta\delta \; +\cdot845\Delta\alpha' \; -\cdot349\Delta\delta' \; -\cdot394\Delta T \; -\cdot560\Delta l \; +\cdot001\Delta\phi' \; +2408\cdot6p \; -995\cdot6s$

Rot^{n} No. 496. o Sagittarii 1880, July 20 5 31 21·30 G.M.T.

$+12''\cdot12 = -\cdot908\Delta\alpha \; -\cdot192\Delta\delta \; +\cdot900\Delta\alpha' \; +\cdot197\Delta\delta' \; -\cdot517\Delta T \; -\cdot626\Delta l \; -\cdot006\Delta\phi' \; -2953\cdot9p \; -996\cdot1s$

Rot^{n} No. 497. o Sagittarii 1880, July 20 6 38 14·84 G.M.T.

$-12''\cdot50 = +\cdot926\Delta\alpha \; +\cdot004\Delta\delta \; -\cdot916\Delta\alpha' \; -\cdot006\Delta\delta \; +\cdot466\Delta T \; +\cdot616\Delta l \; +\cdot007\Delta\phi' \; +2241\cdot4p \; -996\cdot0s$

Rot^{n} No. 498. 44 Aquarii 1880, July 23 16 47 57·99 G.M.T.

$-10''\cdot11 = +\cdot410\Delta\alpha \; +\cdot911\Delta\delta \; -\cdot408\Delta\alpha' \; -\cdot903\Delta\delta' \; +\cdot413\Delta T \; +\cdot439\Delta l \; -\cdot017\Delta\phi' \; +588\cdot3p \; -966\cdot7s$

Rot^{n} No. 499. η Piscium 1880, July 27 12 20 16·99 G.M.T.

$+13''\cdot63 = -\cdot829\Delta\alpha \; -\cdot519\Delta\delta \; +\cdot824\Delta\alpha' \; +\cdot513\Delta\delta' \; -\cdot425\Delta T \; -\cdot513\Delta l \; -\cdot000\Delta\phi' \; -3021\cdot5p \; -912\cdot6s$

Rot^{n} No. 500. η Piscium 1880, July 27 13 35 56·10 G.M.T.

$-11''\cdot91 = +\cdot810\Delta\alpha \; +\cdot549\Delta\delta \; -\cdot802\Delta\alpha' \; -\cdot544\Delta\delta' \; +\cdot380\Delta T \; +\cdot508\Delta l \; -\cdot002\Delta\phi' \; +2566\cdot5p \; -912\cdot0s$

Rot^{n} No. 501. 36 Tauri 1880, July 30 14 10 59·47 G.M.T.

$-\;3''\cdot78 = +\cdot369\Delta\alpha \; +\cdot916\Delta\delta \; -\cdot370\Delta\alpha' \; -\cdot912\Delta\delta' \; +\cdot278\Delta T \; +\cdot257\Delta l \; -\cdot006\Delta\phi' \; +2965\cdot7p \; -887\cdot9s$

Rot^{n} No. 502. 28 Sagittarii 1880, Aug. 16 9 20 38·33 G.M.T.

$+11''\cdot35 = -\cdot884\Delta\alpha \; -\cdot284\Delta\delta \; +\cdot872\Delta\alpha' \; -\cdot279\Delta\delta' \; -\cdot423\Delta T \; -\cdot603\Delta l \; +\cdot009\Delta\phi' \; +962\cdot1p \; -983\cdot0s$

Rot^{n} No. 503. 30 Sagittarii 1880, Aug. 16 11 40 47·36 G.M.T.

$+12''\cdot90 = -\cdot900\Delta\alpha \; +\cdot222\Delta\delta \; +\cdot892\Delta\alpha' \; -\cdot223\Delta\delta' \; -\cdot435\Delta T \; -\cdot563\Delta l \; +\cdot005\Delta\phi' \; +2771\cdot cp \; -983\cdot2s$

Rot^{n} No. 504. 31 Sagittarii 1880, Aug. 16 12 16 47·35 G.M.T.

$+11''\cdot82 = -\cdot890\Delta\alpha \; -\cdot267\Delta\delta \; +\cdot886\Delta\alpha' \; +\cdot261\Delta\delta' \; -\cdot545\Delta T \; -\cdot606\Delta l \; +\cdot013\Delta\phi' \; +2290\cdot4p \; -983\cdot2s$

Digitized by Google

Rot^{n} No. 505.		δ Scorpii		1880, Oct. 7			h m s 6 2 50·76	G.M.T.
+ 6″·37 =	−·589Δα	−·769Δδ	+·589Δα′	+·760Δδ′	−·325ΔT	−·319Δl	+·017Δφ′	+ 684·6p −973·18
Rot^{n} No. 507.		δ Scorpii		1880, Oct. 7			6 43 18·46	G.M.T.
−19″·98 =	+·615Δα	−·745Δδ	−·609Δα′	+·745Δδ′	+·361ΔT	+·451Δl	+·004Δφ′	−3113·8p −973·18
Rot^{n} No. 508.		π Sagittarii		1880, Oct. 10			7 4 55·56	G.M.T.
+ 8″·53 =	−·807Δα	+·499Δδ	+·796Δα′	−·494Δδ′	−·274ΔT	−·444Δl	−·003Δφ′	+2104·0p −968·58
Rot^{n} No. 510.		π Sagittarii		1880, Oct. 10			7 49 30·28	G.M.T.
− 7″·60 =	+·286Δα	+·952Δδ	−·287Δα′	−·939Δδ′	+·301ΔT	+·288Δl	−·017Δφ′	+ 390·1p −968·48
Rot^{n} No. 511.		33 Sagittarii		1880, Nov. 6			7 36 53·24	G.M.T.
+ 9″·15 =	−·658Δα	+·705Δδ	+·652Δα′	−·704Δδ′	−·261ΔT	−·349Δl	−·003Δφ′	+3204·4p −980·88
Rot^{n} No. 512.		26 Arietis		1880, Dec. 12			9 10 52·67	G.M.T.
+ 7′·39 =	−·771Δα	−·583Δδ	+·760Δα′	+·578Δδ′	−·315ΔT	−·480Δl	+·008Δφ′	− 660·5p −901·78

Digitized by Google

AUTHORITIES FOR STAR PLACES WHICH ARE NOT CONTAINED IN NEWCOMB'S ZODIACAL CATALOGUE.

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
W.B. VIII. 85 -	1834	8 3 50·91	1825	1	+23 37 49·8	1825	1
Lalande 26414 -	1834	14 19 40·47	1800	1	− 9 15 19·1	1800	1
Piazzi XIV. 89 -		40·50	1800	9	16·8	1800	10
W.B. XIV. 375 -		40·54	1825	3	21·1	1825	3
Cape 1850, No. 2575		40·24	1852·36	2	20·2	1851·47	1
Paris 1860 - -		40·29	1858·90	2	19·8	1858·39	1
Paris 1875 - -		40·21	1874·20	5	21·4	1874·20	5
		14 19 40·34			− 9 15 19·8		
Lalande 46940 -	1834	23 48 37·45	1800	1	− 6 22 36·8	1800	1
W.B. XXIII. 1016 -		37·85	1825	1	45·7	1825	1
		23 48 37·65			− 6 22 41·3		
W.B. XXIII. 1029 -	1834	23 49 16·21	1825		− 6 23 1·5	1825	1
Lalande 26280 -	1836	14 14 36·81	1800	1	−10 57 38·0	1800	1
Lalande 26307 -	1836	14 15 52·38	1800	1	−10 55 15·6	1800	1
Piazzi XIV. 70 -		52·58	1800	11	12·3	1800	12
W.B. XIV. 297 -		52·71	1825	1	15·5	1825	1
Cape 1850, No. 2561		52·48	1851·99	2	15·6	1851·47	1
Paris 1860 - -		52·47	1856·40	1	17·3	1856·40	1
Washington 5948 -		52·35	1876·40	3	16·3	1874·00	2
Paris 1875 - -		52·40	1879·33	1	18·0	1879·33	1
		14 15 52·47			−10 55 15·6		
Lalande 29840 -	1836	16 15 34·82	1800	1	−23 4 19·2	1800	1
Piazzi XVI. 68 -		34·99	1800	14	25·8	1800	12
O.A. 15613/4/5 -		35·02	1850	3	27·4	1850	3
Paris 1860 - -		34·99	1857·43	2	29·1	1857·36	1
Washington 6786 -		34·77	1875·20	7	30·6	1874·80	3
		16 15 34·91			−23 4 27·1		

There seems to be proper motion in Declination of about −·″061.

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
Lalande 29843 -	1836	16 15 (45·54)	1800	1	−23 1 (7·1)	1800	1
Piazzi XVI. 72 -		46·07	1800	14	10·9	1800	16
O.A. 15621/2 -		46·04	1850	2	11·7	1850	2
Cape 1850, No. 3025		45·79	1852·05	2	13·8	1850·97	2
Paris 1860 - -		45·71	1855·50	1	15·8	1855·50	1
Washington 6790 -		45·82	1876·40	2	13·9	1874·80	6
Paris 1875 - -		45·84	1879·43	1	14·4	1879·43	1
		16 15 45·89			−23 1 13·2		
O.A. 21626 - -	1836	21 37 22·51	1850	1	−18 40 15·2	1850	1
Lalande 14185 -	1837	7 10			+28 24		
*W.B. VII. 332/3 -		10·83	1825	2	54·1	1825	2
Cambridge Zones -		11·22	1877·87	3	53·6	1877·87	3
		7 10 11·12			+28 24 53·7		
* The two Observations in R.A. of W.B. VII. 332/3 differ 0·″91.							
Piazzi XVII. 6 -	1837	17 4 5·84	1800	14	−26 46 48·3	1800	15
Cape 1840, No. 2275		5·62	1836·70	7	53·6	1834·53	6
O.A. 16481 - -		5·72	1850	1	53·8	1850	1
Cape 1850, No. 3231					55·7	1851·08	2
Washington 7130 -		5·57	1862·60	3	55·5	1869·50	3
Stone 9368 - -		5·58	1878·53	3	56·6	1878·53	3
		17 4 5·66			−26 46 53·9		
There seems to be a proper motion in Declination of about −·″068.							
Lalande 30391 -	1844	16 34			−22 13		
O.A. 15890/1 -		57·91	1850	2	26·0	1850	2
O.A. 15929/30/31 -	1844	16 37 8·20	1850	3	−22 20 11·5	1850	3
Lalande 29338 -	1846	15 59 15·06	1800	1	−17 49 9·3	1800	1
O.A. 15265/7 -		15·09	1850	2	14·3	1850	2
Paris 1860 - -		15·18	1858·83	2	16·4	1858·30	1
Paris 1875 - -		15·13	1870·47	1	18·6	1870·47	1
Cape 1880 - -		15·17	1880·53	3	18·0	1880·53	3
		15 59 15·14			−17 49 14·3		
This star seems to have a well-marked proper motion in Declination of about − 0·″128.							
Lalande 22421 -	1848	11 46 3·67	1800	1	+ 1 23 50·2	1800	1
Piazzi XI. 178 -		3·60	1800	5	54·8	1800	7
W.B. XI. 794 -		3·48	1825	1	50·8	1825	1
Paris 1860 - -		3·39	1857·78	2	51·8	1857·30	1
Paris 1875 - -		3·70	1870·23	1	51·5	1870·23	1
		11 46 3·55			+ 1 23 52·4		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observations.	No. of Observations.
		h m s			° ′ ″		
Lalande 16224 -	1848	8 9 39·41	1800	1	+16 8 45·3	1800	1
W.B. VIII. 211 -		39·41	1825	1	43·5	1825	1
		8 9 39·34			+16 8 44·4		
Lalande 41168 -	1849	21 6 10·76	1800	1	−14 45(57·3)	1800	1
Paris 1860 - -		10·83	1854·67	1	46 4·0	1856·58	1
Cape 1880 - -		10·81	1880·72	3	3·2	1880·72	3
		21 6 10·81			−14 46 3·5		
Lalande 12358 -	1850	6 19 59·39	1800	1	+20 19 45·3	1800	1
Washington 2630 -		59·24	1866·10	2	43·6	1867·10	2
Paris 1860 - -		59·31	1855·90	1			
Paris 1875 - -		59·22	1880·08	2	42·6	1880·08	2
		6 19 59·27			+20 19 43·4		
Lalande 17615 -	1850	8 48 17·40	1800	1	+18 3(17·2)	1800	1
Piazzi VIII. 213 -		17·64	1800	4	12·8	1800	4
W.B. VIII. 1203 -		17·51	1825	1	11·9	1825	1
Paris 1860 - -		17·77	1860·82	3	12·1	1862·21	2
Washington 3764 -		17·86	1861·80	5	13·0	1857·70	4
		8 48 17·72			+18 3 12·6		
Lalande 17633 -	1850	8 48 41·82	1800	1	+17 43 0·4	1800	1
Piazzi VIII. 217 -		41·94	1800	6	4·7	1800	7
W.B. VIII. 1208 -		41·55	1825	1	0·5	1825	1
		8 48 41·81			+17 43 3·0		
O.A. 17592 - -	1851	17 56 33·94	1850	1	−21 8 43·1	1850	1
Cape 1880 - -		33·77	1880·59	2	44·2	1880·59	2
		17 56 33·84			−21 8 43·8		
Lalande 33171 -	1851	17 58 24·89	1800	2	−21 12 40·4	1800	2
O.A. 17648 - -		24·75	1850	1	42·2	1850	1
Washington 7632 -		24·88	1874·30	4	42·5	1869·10	2
Paris 1875 - -		24·93	1873·91	3	43·0	1872·60	2
Cape 1880 - -		25·04	1880·63	3	42·6	1880·63	3
		17 58 24·91			−21 12 42·4		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observations.	No. of Observations.
		h m s			° ′ ″		
Lalande 33164 -	1851	17 58 15·46	1800	1	−21 27 14·1	1800	1
Piazzi XVII. 356 -		15·33	1800	24	12·3	1800	23
Paris 1860 - -		15·24	1858·59	1	15·1	1858·59	1
Washington 7631 -		15·18	1865·50	5	12·5	1871·60	3
Paris 1875 - -		15·18	1879·53	2	12·3	1879·53	2
Cape 1880 - -		15·16	1880·66	2	12·6	1880·66	2
		17 58 15·23			−21 27 12·9		
Lalande 24306 -	1852	12 57 3·48	1800	1	+ 0 4 4·2	1800	1
Paris 1860 - -		3·50	1860·64	3	3·6	1861·65	3
Paris 1875 - -		3·44	1868·27	1	4·7	1869·27	2
Cape 1880 - -		3·40	1880·47	2	3·6	1880·47	2
Nicolaiev - -		3·39	1884·04	2	3·1	1884·04	2
		12 57 3·44			+ 0 4 3·8		
Lalande 27713 -	1852	15 5 37·19	1800	2	−13 27(50·3)	1800	2
W.B. XV. 79 -		36·96	1825	3	56·9	1825	3
Paris 1860 - -		36·90	1857·19	1	55·0	1858·42	1
Washington 6259 -		36·89	1860·10	4	56·8	1859·40	3
Paris 1875 - -		36·90	1870·40	4	55·0	1870·40	4
Cape 1880 - -		36·88	1880·48	3	54·1	1880·48	3
		15 5 36·92			−13 27 55·5		
Lalande 27729 -	1852	15 6 7·84	1800	2	−13 39(12·8)	1800	2
W.B. XV. 91 -		7·90	1825	3	8·1	1825	3
Paris 1860 - -		7·71	1855·93	2	9·3	1859·84	2
Washington 6261 -		7·73	1859·70	3	9·0	1855·50	2
Cape 1880 - -		7·80	1880·50	3	8·5	1880·50	3
		15 6 7·78			−13 39 8·8		
Lalande 29395 -	1852	16 1 24·11	1800	1	−17 56 33·2	1800	1
O.A. 15316/7 -		24·22	1850	2	33·5	1850	2
Paris 1860 - -		24·24	1857·42	2	36·1	1856·44	1
Paris 1875 - -		24·05	1879·44	1	42·7	1879·44	1
Cape 1880 - -		24·09	1880·48	4	38·3	1880·49	3
		16 1 24·15			−17 56 36·9		
There is some appearance of proper motion in Declination.							
Lalande 33386 -	1852	18 4 3·22	1800	2	−23 8 51·2	1800	2
Cape 1850, No. 3496		3·25	1850·63	2	51·8	1850·58	2
Washington 7683 -		3·13	1864·60	2	52·2	1872·10	4
Cape 1880 - -		3·18	1880·55	3	51·0	1880·55	3
		18 4 3·19			−23 8 51·6		
O.A. 20874/5 -	1852	20 40 40·96	1850	2	−21 9 52·9	1850	2
Cape 1880 - -		41·51	1880·76	2	10 3·9	1880·76	2
		20 40 41·00			−21 9 53·6		
	Approximate proper motions - - -				{ R.A. +·ˢ018 Dec. −·″37		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
O.A. 20885 - -	1852	20 41 15·48	1850	1	−21 8 58·1	1850	1
Cape 1880 - -		15·79	1880·68	1	56·5	1880·68	1
		20 41 15·64			−21 8 57·3		
O.A. 21591 - -	1852	21 35 21·08	1850	1	−18 3 34·6	1850	1
Cape 1880 - -		20·89	1880·74	3	38·4	1880·74	3
		21 35 20·97			−18 3 36·9		
Lalande 43998 -	1852	22 24			−14 21		
W.B. XXII. 506 -		15·54	1825	1	16·3	1825	1
Cape 1880 - -		15·47	1880·72	3	15·7	1880·72	3
		22 24 15·49			−14 21 15·9		
Lalande 28453 -	1853	15 30 20·46	1800	1	−17 10 37·0	1800	1
O.A. 14724/5 - -		20·53	1850	2	39·6	1850	2
Paris 1860 - -		20·42	1855·43	1	43·0	1855·43	1
Washington 6435 -		20·36	1860·90	2	42·2	1855·70	3
Paris 1875 - -		20·35	1870·38	2	41·6	1870·38	2
Cape 1880 - -		20·30	1880·50	3	42·2	1880·50	3
		15 30 20·39			−17 10 41·3		
Lalande 41255 -	1853	21 8 19·61	1800	1	−20 46 43·0	1800	1
Piazzi XXI. 41 -		19·93	1800	6	47·6	1800	8
O.A. 21258/9 - -		19·55	1850	2	53·2	1850	2
Washington 9284 -		19·32	1877·40	3	54·6	1874·80	4
Paris 1875 - -		19·29	1879·76	3	55·4	1879·76	3
		21 8 19·50			−20 46 52·1		
There seems to be proper motion in Declination of about −0″·104.							
Lalande 477 - -	1853	0 16 59·34	1800	1	− 3 1 55·7	1800	1
Piazzi 0·60 - -		59·18	1800	13	55·9	1800	21
Paris 1845 - -		59·03	1840·19	5	56·0	1841·80	1
Cape 1850, No. 45 -		59·08	1851·90	2	56·7	1850·80	2
Paris 1860 - -		59·01	1858·28	2	58·3	1858·09	3
Washington 172 -		59·06	1853·40	5	55·3	1868·30	2
Paris 1875 - -		59·01	1879·76	1	57·0	1879·76	1
		0 16 59·08			− 3 1 56·5		
Lalande 21570 -	1854	11 11 15·00	1800	1	+11 23(45·0)	1800	1
W.B. XI. 175 - -		14·83	1825	1	39·0	1825	1
Paris 1860 - -		15·22	1860·28	2	40·2	1860·28	2
Leipsic - - -		15·25	1869·28	2	40·2	1869·28	2
Cape 1880 - -		15·40	1880·43	2	40·4	1880·43	2
		11 11 15·22			+11 23 40·1		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
Lalande 26631 -	1854	14 29 17·35	1800	2	−11 41 17·5	1800	2
Piazzi XIV. 127 -		17·41	1800	25	13·0	1800	18
Cape 1850, No. 2592		14·29	1850·57	1	40 54·7	1851·34	2
Paris 1860 - -		13·73	1859·42	3	52·8	1859·65	4
Paris 1875 - -		12·78	1875·39	2	47·8	1875·39	2
		14 29 14·81			−11 40 58·2		
This star has well marked proper motions in R.A. and Declination of about −0·061 and +0″·35 respectively.							
Lalande 22678 -	1854	11 56 49·84	1800	1	+ 5 44 44·3	1800	1
W.B. XI. 972 - -		49·84	1825	1	44·9	1825	1
Paris 1860 - -		50·08	1857·31	1	44·0	1857·31	1
Paris 1875 - -		50·02	1877·65	3	43·8	1877·65	3
Cape 1880 - -		50·22	1880·44	1	44·4	1880·44	1
		11 56 50·04			+ 5 44 44·2		
Piazzi XVII. 365 -	1854	18 0 11·37	1800	8	−26 6 55·1	1800	8
O.A. 17701/2/3 -		11·09	1850	3	7 9·1	1850	3
Cape 1850, No. 3478		11·04	1852·61	2	7 11·8	1851·66	1
Stone 9884 - -		10·97	1879·24	2	7 20·4	1879·24	2
		18 0 11·12			−26 7 8·9		
This star seems to have a proper motion in Declination of about −0″·317.							
Lalande 35947 -	1854	19 4 13·75	1800	1	−26 8 47·3	1800	1
Piazzi XIX. 7 -		14·05	1800	15	46·0	1800	12
O.A. 19245 - -		14·08	1850	1	46·0	1850	1
Cape 1850, No. 3782		13·98	1851·72	2	48·2	1851·02	2
Paris 1860 - -		13·99	1858·08	4	49·1	1860·62	2
Washington 8179 -		13·87	1863·10	6	47·6	1866·30	5
Stone 10430 - -		13·70	1878·62	3	48·2	1878·62	3
Paris 1875 - -		14·17	1879·61	2	48·3	1879·61	2
		19 4 13·95			−26 8 47·7		
Lalande 36100 -	1854	19 7 12·62	1800	1	−25 54 53·9	1800	1
Cape 1850, No. 3792		13·02	1851·58	3	56·8	1850·95	2
O.A. 19305 - -		13·06	1850	1	57·4	1850	1
Paris 1860 - -		12·95	1855·53	1	57·6	1855·53	1
Washington 8201 -		12·90	1861·90	7	58·1	1860·00	3
Paris 1875 - -		12·85	1876·06	2	56·9	1876·06	2
Stone 10454 - -		12·95	1878·60	3	57·3	1878·60	3
		19 7 12·93			−25 54 57·1		
Piazzi V. 41 - -	1860	5 12 12·04	1800	6	+27 48(44·4)	1800	7
Greenw. 1860, 388 -		12·14	1854·10	3	39·7	1854·10	3
Stone 2338 - -		12·03	1877·03	3	38·9	1877·03	3
Cambridge Zones -		12·06	1879·78	3	38·2	1879·78	3
		5 12 12·07			+27 48 38·9		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
Lalande 13554 -	1860	6 53 44·01	1800	1	+25 33 46·5	1800	1
W.B. VI. 1609/10 -		44·54	1825	2	47·7	1825	2
Paris 1875 - -		44·37	1872·11	1	42·4	1872·11	1
Cambridge Zones -		44·27	1874·68	2	41·5	1874·68	2
		6 53 44·30			+25 33 43·4		
Lalande 38096 -	1860	19 52 21·05	1800	1	−20 14 10·3	1800	1
Paris 1860 - -		21·11	1858·59	1	10·7	1858·59	1
Paris 1875 - -		21·28	1879·54	1	10·5	1879·54	1
		19 52 21·17			−20 14 10·5		
Lalande 42073 -	1860	21 29 46·50	1800	2	−12 5 7·4	1800	2
W.B. XXI. 695 -		46·59	1825	2	13·9	1825	2
Paris 1860 - -		46·49	1857·74	1	11·6	1856·69	2
Paris 1875 - -		46·52	1880·15	2	9·4	1880·15	2
		21 29 46·52			−12 5 10·5		
Lalande 42160 -	1860	21 31(56·25)	1800	2	−11 12(11·7)	1800	2
W.B. XXI. 749 -		(56·81)	1825	1	(18·1)	1825	1
Paris 1860 - -		56·29	1854·64	2	18·8	1857·17	2
		21 31 56·29			−11 12 18·8		
Lalande 45233 -	1860	23 0 34·81	1800	3	− 1 3 8·4	1800	3
W.B. XXII. 1269 -		34·96	1825	1	9·9	1825	1
Paris 1875 - -		34·93	1877·43	3	9·7	1877·43	3
Nicolaiev - -		34·99	1877·63	2	10·0	1877·63	2
		23 0 34·93			− 1 3 9·5		
Lalande 46737 -	1860	23 44(31·61)	1800	1	+ 3 55 (4·6)	1800	1
W.B. XXIII. 894 -		(31·21)	1825	1	(6·2)	1825	1
Paris 1860 - -		30·90	1861·43	6	5·8	1861·76	7
		23 44 30·90			+ 3 55 5·8		
Lalande 46742 -	1860	23 44 44·10	1800	1	+ 3 57 60·7	1800	1
W.B. XXIII. 898 -		44·21	1825	1	59·5	1825	1
Paris 1860 - -		43·93	1860·80	2	59·7	1860·00	4
		23 44 44·02			+ 3 57 59·8		
Lalande 2312 -	1860	1 10 8			+13 30		
W.B. I. 140 - -		8·17	1825	1	14·1	1825	1
Leipsic - -		8·12	1869·96	2	14·3	1869·96	2
		1 10 8·13			+13 30 14·3		

Digitized by Google

Name.	Epoch to which Star's Place is reduced by Precession.	Mean R.A. at Epoch.	Mean Year of Observation.	No. of Observations.	Mean Declination at Epoch.	Mean Year of Observation.	No. of Observations.
		h m s			° ′ ″		
Piazzi III. 175 -	1860	3 43. 2·05	1800	5	+24 44 12·0	1800	5
Cape 1860, No. 131 -		2·54	1860·93	1	12·5	1860·93	1
		3 43 2·30			+24 44 12·3		
Lalande 7114 -	1860	3 43(49·92)	1800	1	+24 44(56·5)	1800	1
Piazzi III. 179 -		49·00	1800	4	50·2	1800	4
Paris 1860 - -		49·42	1857·99	1	43·6	1857·99	1
Cape 1860, No. 133 -		49·39	1860·92	3	42·3	1860·92	3
Paris 1875 - -		49·38	1871·92	1	40·3	1871·92	1
		3 43 49·40			+24 44 42·1		
This star seems to have a proper motion in Declination of about −0″·152.							
Washington 9439 -	1863	21 29 50·33	1867·30	2	− 8 25 40·2	1867·70	2
Cape 1880 - -		50·28	1880·70	3	40·1	1880·70	3
		21 29 50·31			− 8 25 40·2		
Piazzi I. 17 - -	1866	1 6 44·64	1800	9	+ 6 52 10·5	1800	7
Washington 622 -		45·31	1864·30	6	9·1	1858·90	3
		1 6 45·31			+6 52 9·8		
W.B. IV. 401 -	1866	4 19 19·39	1825	1	+17 54 8·9	1825	1
Lalande 39819 -	1867	20 32 (6·76)	1800	1	−15 26(26·2)	1800	1
Piazzi XX. 229 -		6·50	1800	5	21·6	1800	5
Paris 1860 - -		6·26	1857·17	2	25·2	1854·73	1
Paris 1875 - -		6·41	1878·73	2	26·0	1878·73	2
		20 32 6·34			−15 26 25·7		
Lalande 33029 -	1880	17 56 35·54	1800	1	−24 18(40·3)	1800	1
O.A. 17540/1 -		35·63	1850	2	45·8	1850	2
Washington 7594 -		35·49	1865·00	9	47·9	1867·60	2
Stone 9829 - -		35·49	1878·63	2	48·0	1878·63	2
		17 56 35·53			−24 18 47·2		
Lalande 19440 -	1880				+ 9 30 3·1	1800	1
Piazzi IX. 212 -		9 50 4·78	1800	23	5·7	1800	16
W.B. IX. 1047 -		4·27	1825	1	3·4	1825	1
Paris 1860 - -		4·38	1856·22	1	3·8	1856·22	1
Paris 1875 - -		4·23	1878·59	5	4·1	1878·59	5
		9 50 4·28			+ 9 30 3·9		
W.B. IX. 1068 -	1880	9 51 5·89	1825	1	+ 9 10 40·2	1825	1
Stone 9138 - -	1880	16 44 2·15	1878·45	3	−24 37 35·9	1878·45	3

Digitized by Google

ADOPTED MEAN PLACES FOR STARS NOT IN NEWCOMB'S ZODIACAL CATALOGUE.

Star's Name.	Date of Observation.	Mean R.A. for Year of Observation.	Mean Declination for Year of Observation.
	1800 +	h m s	° ′ ″
Lal. 16053 -	34 Mar. 20 -	8 3 50·91	+23 37 49·8
26414 -	34 July 14 -	14 19 40·34	− 9 15 19·8
46940 -	34 Dec. 8 -	23 48 37·65	− 6 22 41·3
46960 -	34 Dec. 8 -	23 49 16·21	− 6 23 1·5
26280 -	36 Feb. 8 -	14 14 36·81	−10 57 38·0
26307 -	36 Feb. 8 -	14 15 52·47	−10 55 15·6
29840 -	36 Sept. 16 -	16 15 34·91	−23 4 27·1
29843 -	36 Sept. 16 -	16 15 45·89	−23 1 13·2
O.A. 21626 -	36 Dec. 12 -	21 37 22·51	−18 40 15·2
Lal. 14185 -	37 May 9 -	7 10 11·12	+28 24 53·7
Piazzi XVII. 6 -	37 Aug. 11 -	17 4 5·66	−26 46 53·3
Lal. 30391 -	44 May 31 -	16 34 57·91	−22 13 26·0
O.A. 15929, 30 31 -	44 May 31 -	16 37 8·20	−22 20 11·5
Lal. 29338 -	46 July 5 -	15 59 15·14	−17 49 14·3
22421 -	48 April 15 -	11 46 3·55	+ 1 23 52·4
16224 -	48 May 8 -	8 9 39·34	+16 8 44·4
41168 -	49 Nov. 21 -	21 6 10·81	−14 46 3·5
12358 -	50 April 17 -	6 19 59·27	+20 19 43·4
17615 -	50 June 13 -	8 48 17·72	+18 3 12·6
17633 -	50 June 13 -	8 48 41·81	+17 43 3·0
O.A. 17592 -	51 Oct. 28 -	17 56 33·84	−21 8 43·8
Lal. 33171 -	51 Oct. 28 -	17 58 24·91	−21 12 42·4
33164 -	51 Oct. 28 -	17 58 15·23	−21 27 12·9
24306 -	52 July 22 -	12 57 3·44	+ 0 4 3·8
27713 -	52 Sept. 17 -	15 5 36·92	−13 27 55·5
27729 -	52 Sept. 17 -	15 6 7·78	−13 39 8·8
29395 -	52 Sept. 18 -	16 1 24·15	−17 56 36·9
33386 -	52 Sept. 20 -	18 4 3·19	−23 8 51·6
O.A. 20874-5 -	52 Oct. 20 -	20 40 41·00	−21 9 53·6
20885 -	52 Oct. 20 -	20 41 15·64	−21 8 57·3
21591 -	52 Oct. 21 -	21 35 20·97	−18 3 36·9
Lal. 43998 -	52 Oct. 22 -	22 24 15·49	−14 21 15·9
28453 -	53 Sept. 8 -	15 30 20·39	−17 10 41·3
41255 -	53 Nov. 7 -	21 8 19·50	−20 46 52·5
477 -	53 Dec. 8 -	0 16 59·08	− 3 1 56·5
21570 -	54 May 7 -	11 11 15·22	+11 23 40·1
26631 -	54 May 11 -	14 29 14·08	−11 40 54·8
22678 -	54 July 29 -	11 56 50·04	+ 5 44 44·2
Piazzi XVII. 365	54 Sept. 1 -	18 0 11·12	−26 7 11·9
Lal. 35947 -	54 Sept. 2 -	19 4 13·95	−26 8 47·7
Lal. 36100 -	54 Sept. 2 -	19 7 12·93	−25 54 57·1
Piazzi V. 41 -	60 Mar. 28 -	5 12 12·07	+27 48 38·9
Lal. 13554 -	60 Apr. 26 -	6 53 44·30	+25 33 43·4
38096 -	60 Nov. 17 -	19 52 21·17	−20 14 10·5
42073 -	60 Nov. 19 -	21 29 46·52	−12 5 10·5
42160 -	60 Nov. 19 -	21 31 56·29	−11 12 18·8
45233 -	60 Nov. 21 -	23 0 34·93	− 1 3 9·5
46737 -	60 Nov. 22 -	23 44 30·90	+ 3 55 5·8
46742 -	60 Nov. 22 -	23 44 44·02	+ 3 57 59·8
2312 -	60 Nov. 24 -	1 10 8·13	+13 30 14·3

Digitized by Google

Star's Name.	Date of Observation.	Mean R.A. for Year of Observation.	Mean Declination for Year of Observation.
	1800 +	h m s	° ′ ″
Piazzi III. 175 -	60 Nov. 27 -	3 43 2·30	+24 44 12·3
Lal. 7114 -	60 Nov. 27 -	3 43 49·40	+24 44 42·6
Wash. 9439 -	63 Nov. 17 -	21 29 50·31	− 8 25 40·2
Piazzi I. 17 -	66 May 11 -	1 6 45·31	+ 6 52 9·8
W.B. IV. 401 -	66 July 8 -	4 19 19·39	+17 54 8·9
Lal. 39819 -	67 Oct. 7 -	20 32 6·34	−15 26 25·7
39819 -	67 Dec. 28 -	20 32 6·34	−15 26 25·7
33029 -	80 Mar. 4 -	17 56 35·53	−24 18 47·2
30599 -	80 Mar. 30 -	16 44 2·15	−24 37 35·9
19440 -	80 June 13 -	9 50 4·28	+ 9 30 3·9
W.B. IX. 1068 -	80 June 13 -	9 51 5·89	+ 9 10 40·2
W.B. IX. 1110 -	80 June 13 -	9 53 6·18	+ 9 0 32·6

Digitized by Google

OCCULTATIONS OF PLANETS OBSERVED AT THE ROYAL OBSERVATORY, CAPE OF GOOD HOPE.

Date.	Planet.	Phenomenon Observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
					h m s	h m s
1834.						
Dec. 17 -	Mars, 1 L - -	D B	Dollond -	T.M.	8 49 13·24	13 50 29·99
„ -	„ 2 L - -	„	„ -	„	8 49 51·86	13 51 8·50
„ -	„ 1 L - -	R D	„ -	„	10 8 17·81	15 9 21·60
„ -	„ 2 L - -	„	„ -	„	10 8 52·40	15 9 56·10
1836.						
Feb. 8 -	Saturn, 1 L -	R D	„ -	„	9 32 45·35	11 6 28·65
„ -	„ 2 L -	R D	„ -	„	9 33 39·50	11 7 22·65
1842.						
Oct. 7 -	Venus, 1 L -	D D	„ -	W.M.	19 49 1·23	5 31 18·67
„ -	„ 1st Cusp -	„	„ -	„	19 49 31·31	5 31 48·67
„ -	„ 2nd „ -	„	„ -	„	19 50 2·39	5 32 19·66
1849.						
Dec. 22 -	Saturn, west edge of ring.	D D	Merz -	T.M.	4 25 53·08	9 6 46·46
„ -	„ „ -	„	Dollond -	W.M.	4 25 50·08	9 6 43·46
„ -	„ „ -	„	Jones -	G.F.C.	4 25 54·48	9 6 47·86
„ -	„ 1 L -	„	Merz -	T.M.	4 26 12·58	9 7 5·90
„ -	„ „ -	„	Dollond -	W.M.	4 26 6·06	9 6 59·40
„ -	„ „ -	„	Jones -	G.F.C.	4 26 3·96	9 6 57·30
„ -	„ 2 L -	„	Merz -	T.M.	4 26 51·28	9 7 44·50
„ -	„ „ -	„	Dollond -	W.M.	4 26 50·58	9 7 43·80
„ -	„ „ -	„	Jones -	G.F.C.	4 26 48·98	9 7 42·20
„ -	„ east edge of ring.	„	Merz -	T.M.	4 27 22·48	9 8 15·61
„ -	„ „ -	„	Dollond -	W.M.	4 27 22·08	9 8 15·21
„ -	„ „ -	„	Jones -	G.F.C.	4 27 16·67	9 8 9·81
1851.						
Oct. 17 -	Mars, 1 L -	D B	Merz -	T.M.	9 31 58·89	18 33 26·88
„ -	„ „ -	„	Dollond -	W.M.	9 31 58·19	18 33 26·18
„ -	„ 2 L -	„	Merz -	T.M.	9 32 17·89	18 33 45·83
„ -	„ „ -	„	Dollond -	W.M.	9 32 17·74	18 33 45·68
1853.						
Jan. 6 -	Venus, 1 L -	D B	Merz -	T.M.	15 50 53·13	19 29 51·58
„ -	„ 2 L -	„	„ -	„	15 51 27·33	19 30 25·69
„ -	„ 1 L -	R D	„ -	„	17 9 49·68	20 48 35·20
„ -	„ 2 L -	„	„ -	„	17 10 22·78	20 49 8·21
1854.						
Aug. 14 -	Uranus - -	D B	Merz -	T.M.	23 49 19·98	13 2 56·89
„ -	„ - -	R D	„ -	„	0 59 18·62	14 12 44·07

Digitized by Google

Date.	Planet.	Phenomenon Observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
1864.					h m s	h m s
Aug. 10 -	Jupiter, 1 L -	D D	Merz -	W.M.	18 19 52·88	7 47 48·93
,, -	,, ,, -	,,	Dollond -	G.M.	18 19 51·24	7 47 47·29
,, -	,, 2 L -	,,	Merz -	W.M.	18 21 33·98	7 49 29·75
,, -	,, ,, -	,,	Dollond -	G.M.	18 21 32·51	7 49 28·28
,, -	,, 1 L -	R B	Merz -	W.M.	19 26 22·76	8 54 7·91
,, -	,, ,, -	,,	Dollond -	G.M.	19 26 32·14	8 54 17·26
,, -	,, 2 L -	,,	Merz -	W.M.	19 28 1·03	8 55 45·91
,, -	,, ,, -	,,	Dollond -	G.M.	19 27 59·38	8 55 44·26
1866.						
May 26 -	Saturn, west edge of ring.	D D	Merz -	G.M.	17 14 22·81	11 43 13·70
,, -	,, ,, -	,,	Dollond -	J.C.S.	17 14 22·51	11 43 13·40
,, -	,, 1 L -	,,	Merz -	G.M.	17 14 55·90	11 43 46·70
,, -	,, ,, -	,,	Dollond -	J.C.S.	17 14 51·89	11 43 42·70
,, -	,, 2 L -	,,	Merz -	G.M.	17 15 45·04	11 44 35·70
,, -	,, ,, -	,,	Dollond -	J.C.S.	17 15 46·54	11 44 37·20
,, -	,, east edge of ring.	,,	Merz -	G.M.	17 16 25·65	11 45 16·20
,, -	,, ,, -	,,	Dollond -	J.C.S.	17 16 25·15	11 45 15·70
,, -	,, west edge of ring.	R B	Merz -	G.M.	18 28 7·90	12 56 46·70
,, -	,, ,, -	,,	Dollond -	T.M.	18 28 26·45	12 57 5·20
,, -	,, 1 L -	,,	Merz -	G.M.	18 28 32·97	12 57 11·70
,, -	,, ,, -	,,	Dollond -	T.M.	18 28 47·01	12 57 25·70
,, -	,, 2 L -	,,	Merz -	G.M.	18 29 2·05	12 57 40·70
,, -	,, ,, -	,,	Dollond -	T.M.	18 28 58·54	12 57 37·20
,, -	,, east edge of ring.	,,	Merz -	G.M.	18 29 31·12	12 58 9·70
,, -	,, ,, -	,,	Dollond -	T.M.	18 29 29·62	12 58 8·20
June 8 -	Mars, 1 L -	D B	Merz -	G.M.	0 16 39·70	17 53 14·56
,, -	,, 2 L -	,,	,, -	,,	0 17 0·75	17 53 35·55

Digitized by Google

OCCULTATIONS OF PLANETS.

Notes.

1834, Dec. 17, Mars.—Observed Immersion at Bright Limb and Emersion at Dark Limb in West Dome with the 46-inch Dollond, power 130. Moon just past the meridian. Mars was very steady, the dark spot or irregular blotch on his disc visible. At Immersion there was no distortion, nor could I remark any accelerated motion when he approached, but the Moon's Limb was undulating a little, which seemed to be imparted to Mars a few seconds before the preceding limb became obscured, but it was slight. On the whole the observation was very satisfactory.

1836, Feb. 8, Saturn.—Observed Emersion at Dark Limb, in West Dome, with the 46-inch Dollond, power 70. Dome floor tremulous.

1842, Oct. 7, Venus.—Observed Immersion at Dark Limb with 46-inch Dollond. Moon's Dark Limb invisible; haze over the sky; telescope much shaken by the wind.

1849, Dec. 22, Saturn.—Observer, T.M.; 8½ ft. Equat.; power 273. Remarkably good definition, and the precision of observation corresponding to it, excepting with respect to West edge of Ring, the Immersion of which was estimated by comparison of breadth with the East edge.

Observer, W.M.; 46-inch Dollond; power 93. The definition good at the Immersion, but there is no certainty in the observation of the contact of the West edge of Ring and Planet; the power employed was too low for the purpose.

Observer, G.F.C.; 5 ft., Jones; power 122.

1851, Oct. 17, Mars.—Observer, T.M.; 8½ ft., Equat.; power 273.

Observer, W.M.; 46-inch Dollond; power 150.

1853, Jan. 6, Venus.—Observed Immersion at Bright Limb and Emersion at Dark Limb, with 8½ ft. Equat.; power 273 at Immersion and 161 at Emersion. Good observations. Gibbous edge of Venus preceding and first immersed; also first emerged. Strong sunshine.

1854, Aug. 14, Uranus.—Observed Immersion at Bright Limb and Emersion at Dark Limb, with 8½ ft. Equat.; power 123.

1864, Aug. 10, Jupiter.—Observer, W.M.; 8½ ft. Equat.; power 273.

Observer, G.M.; 46-inch Dollond; power not noted.

1866, May 26, Saturn.—Observer, G.M.; 8½ ft. Equat.; power 123.

Observer, J.C.S.; 46-inch Dollond; power 92.

Observer, T.M.; „ „

1866, June 8, Mars.—8½ ft. Equat.; power 123. Good, though boiling.

Digitized by Google

OCCULTATIONS OF STARS IN THE PLEIADES OBSERVED AT THE ROYAL OBSERVATORY, CAPE OF GOOD HOPE.

Rotation Number.	Date.	Star.	Phenomenon observed.	Instrument.	Observer.	Cape Sidereal Time.	Greenwich Mean Time.
						h m s	h m s
1	1837, Nov. 12	23 Tauri -	D. B.	Jones -	T. M.	5 22 39·64	12 41 1·99
2	1838, Feb. 2 -	Pleiadum -	D. D.	„ -	C. P. S.	6 24 44·00	8 20 31·38
3		Pleiadum -	D. D.	„ -	C. P. S.	6 33 21·23	8 29 7·20
4		Pleiadum -	D. D.	„ -	C. P. S.	7 12 21·24	9 8 0·82
5	1838, Aug. 12	Pleiadum -	D. B.	Dollond -	T. M.	0 23 30·60	13 45 22·37
6		Pleiadum -	D. B.	„ -	T. M.	2 15 23·80	15 36 57·24
7		19 Tauri -	R. D.	„ -	T. M.	1 26 13·45	14 47 54·95
8		Pleiadum -	R. D.	Jones -	C. P. S.	1 25 53·22	14 47 3¼·77
9		Pleiadum -	R. D.	„ -	C. P. S.	1 50 10·80	15 11 48·37
10		Pleiadum -	R. D.	„ -	C. P. S.	1 52 13·73	15 13 50·96
11	1856, Nov. 12	η Tauri - -	D. B.	Merz -	W. M.	0 25 8·24	7 42 45·33
12		η Tauri - -	R. D.	„ -	W. M.	1 29 59·81	8 47 26·27
13	1879, Oct. 31	17 Tauri -	D. B.	„ -	D. G.	23 24 12·21	7 31 23·06
14		„ -	„	Dollond -	R. T. P.	23 23 57·70	7 31 8·59
15		20 Tauri -	D. B.	Merz -	D. G.	23 53 4·00	8 0 10·12
16		„ -	„	Dollond -	R. T. P.	23 52 59·41	8 0 5·54
17		20 Tauri -	R. D.	Merz -	D. G.	1 9 46·81	9 16 40·72
18		„ -	„	Dollond -	R. T. P.	1 9 46·50	9 16 40·41
19		16 Tauri -	R. D.	Merz -	D. G.	0 30 6·74	8 37 6·79
20		19 Tauri -	R. D.	„ -	W. H. F.	0 51 1·91	8 57 58·53

1, 2, 3, 4, 5, 6, 7, 8, 9, 10. Fair observations.
11, 12. Cloudy; the star very faint, but fair observations.
13, 14, 15, 16, 17, 18, 19, 20. Clouds continually drifting over the Moon.

Digitized by Google

ANNALS OF THE CAPE OBSERVATORY.

VOL. I., PART 5.

ON THE VARIATIONS OF THE INSTRUMENTAL ADJUSTMENTS OF THE CAPE TRANSIT-CIRCLE.

BY

W. H. FINLAY, M.A., *Chief Assistant.*

PUBLISHED BY ORDER OF THE LORDS COMMISSIONERS OF THE ADMIRALTY, IN OBEDIENCE TO HER MAJESTY'S COMMAND.

a (3)1958. 400.—1/98.

Digitized by Google

Digitized by Google

ON THE VARIATIONS OF THE INSTRUMENTAL ADJUSTMENTS OF THE CAPE TRANSIT-CIRCLE.

ATTENTION has been directed more than once in the volumes of Cape observations to the large variations in the instrumental adjustments of this Transit-circle in the course of the year and in successive years: variations of such magnitude as were scarcely to be looked for in such a massive instrument. The changes of level attracted attention very soon after the erection of the instrument in 1855 and were generally attributed to the effects of rain-fall. Sir T. Maclear frequently refers to them in the "Weekly Register" of the Observatory, and on several occasions made observations of the level and nadir-point at various hours of the day and night to detect whether the changes were due to temperature. He came to the conclusion that there was no evidence of such dependency. Again, in 1856, June 23, he writes: "a north-wester with rain prevailed during the greater part of the week . . . . The opportunity was taken to watch the effect of the rain on the nadir-point and inclination of the axis, to which (rain) has been attributed the sinking of the West pier. Whether or not the ground was saturated before this fall, the latter had little effect on either the inclination or nadir-point." In the introduction to the Cape observations for 1875, Mr. Stone writes: "I have had numerous determinations of the level and nadir-point corrections made at different hours of the day, to test the stability of the instrument over short periods of time. The stability over short periods appears satisfactory, but the annual fluctuations are large . . . . When the Transit-circle was first mounted in 1855, and for some years afterwards, the annual fluctuations, although well marked, were smaller; but since 1864 they have been nearly as large as at present. The position of the Transit-circle appears to be influenced by the amount of back-water in the rivers around the hill upon which the Observatory stands. These back-waters have increased considerably since the narrowing of the outlet of the Salt River by the railway works in progress about 1860; but I cannot distinctly trace the increased annual changes much further back than 1864." In the introduction to the observations for 1876, however, he omits this explanation. Again, in 1879, Mr. Gill had a large number of levels taken about 6^h and 18^h mean time, but no appreciable difference following any regular law was found between these and the usual determination about midnight.

It will be seen, therefore, that the changes of the instrumental adjustments have always been a subject of particular attention, and as a natural consequence the determinations of them are very numerous and regular. In the present paper I propose to collect together and discuss the observations for the 27 years from 1856 to 1882.

The following description of the piers is given by Sir T. Maclear in his report for 1855:—

Digitized by Google

"The pedestal of the Transit-circle piers is a block of masonry 15 feet long in the prime vertical, 11 feet in the direction of the meridian, and about 5 in depth; built with large blocks of hard stone, united with Parker's Roman cement; and resting upon the natural clay-slate without other intervening material than a thin stratum of the same cement. This conglomerate block is supposed to be impervious to moisture. Each pier is 6 feet 10 inches in length, meridian-wise: 3 feet 9½ inches wide, and 13 feet 3 inches in height above the surface of the pedestal.

The East pier consists of 14 blocks of rectangular cut stone, of weights from 5½ tons to about ½ a ton. Three of the lower courses are each of a single block, and each of the two courses above the axis opening has a block which runs the whole length of the pier. The material of two courses is Table mountain sand-stone, taken from the late mural-circle pier: that of the others is hard white sand-stone from a quarry near Tigerberg.

The West pier consists of five courses, composed of 25 blocks, of which eleven (together equal to 68 cubic feet) are of an artificial stone, with the perforations which constitute the microscope tubes, and the channels for the rays from the illuminating lenses. The first course is a singe block of Table mountain sand-stone, of about 11 tons in weight, taken from the mural-circle pier. The next three courses are composed of artificial stone, and of the hard white sand-stone from Tigerberg quarry. The fifth or upper course consists of three blocks of the white sand-stone,—one of them, as a *binder*, running the whole length of the pier. Strictly speaking, however, the West pier consists of six courses: for there is a thin one of flag-stone (2¾ inches) intervening between the first and second above-mentioned to raise the latter to its proper level, owing to the original plan not taking into account the depth of the cast-iron bearing block. The seams of the piers are grouted with Parker's Roman cement. An insulating wall whose base is on a level with the foundation of the pedestal, separates the pedestal and piers from the side soil, except where the wing-walls of the East pier butt against the pier. A few inches of the lower and inner courses of these walls rest upon the projecting step of the pedestal." The whole weight supported by the two piers is about 6 tons: of this the West pier carries 2¼ tons, while the East pier carries 1½ tons additional, viz., the mercury trough and fittings. The residual weight on each Y was 140 lbs. up to 1864 April 5, when extra weights were placed on the counter-poises reducing this pressure to 45 lbs. on each. I have not been able to ascertain when these additional weights were removed, but they have not been on for many years.

The Observatory is built on the northern end of an elevated piece of land (clay-slate), about 35 feet above sea-level. To the north the ground gradually slopes downwards for about 150 yards: to the South it is nearly level for several miles. On the East and West are two small streams which carry off a great part of the rain which falls on the Eastern slope of the Table mountain range: and the plain to the north is crossed at a distance of about half-a-mile by a railway embankment, which runs roughly east and west. The flat ground between the foot of the Observatory hill and this embankment is usually more or less flooded in the winter time, more especially on the eastern side. The eastern and southern sides of the hill are well sheltered by trees, but the northern and western sides are fully exposed to the sun's rays. On the west, at about a distance of a couple of miles is the Table mountain range; while towards the east there is a long stretch of low sandy flats for about 30 miles.

Digitized by Google

A plan of the Observatory building will be found in Vol. xix. of the Royal Astronomical Society's Memoirs. The Transit-circle occupies the position of the old mural-circle.

II.

Since the erection of the instrument the West Pier has been continually sinking (or the East Pier rising), so that it has been found necessary to alter the level on three occasions, by the insertion of tin-foil under the bearing plate of the western pivot. These changes were effected in 1856, 1860, and 1872; and the level error at present is again so large that another adjustment will soon be necessary. The inclination of the axis was determined on each occasion shortly before and after the insertion of the tin-foil, so that there is no difficulty in bridging these gaps and forming a table of the level errors reduced to one uniform system. In forming such a table of semi-monthly levels (Table I.), the mean of the level errors determined within a few days of the first of the month has been taken as the level error on the first, and similarly for the fifteenth of the month. A like plan has been followed for the Azimuths and Nadir Point readings. The semi-monthly values for 1883 and 1884 are given in the Tables, but the results for these years were not available when I began this investigation, and they have not been included; they will serve, however, as a valuable check on any general results derived from the other years.

LEVEL ERROR.

The means of the semi-monthly values for the 27 years, 1856—1882, are:—

	s		s		s		s
Jan. 1	−0·510	Apr. 1	−1·311	July 1	−1·419	Oct. 1	−0·808
15	−0·599	15	−1·441	15	−1·284	15	−0·732
Feb. 1	−0·732	May 1	−1·519	Aug. 1	−1·173	Nov. 1	−0·675
15	−0·862	15	−1·552	15	−1·066	15	−0·643
Mar. 1	−1·019	June 1	−1·549	Sept. 1	−0·983	Dec. 1	−0·621
15	−1·186	15	−1·534	15	−0·884	15	−0·648

It will be seen later on that the level error is subject to a constant annual change amounting to $-0^{s}\cdot146$: applying, therefore, a proportional part of this to each of the above values, and assuming that these corrected means may be represented by an expression of the form

$$L_0 + a \sin (\odot + A) + b \sin (2 \odot + B).$$

or, which is the same thing—

$$L_0 + x \cos \odot + y \sin \odot + x' \cos 2 \odot + y' \sin 2 \odot$$

where L_0 = the mean of all the semi-monthly values = $-1^{s}\cdot031$.

$\odot = 15°$ for Jan. 15.

$= 30°$ for Feb. 1, &c., &c.

Digitized by Google

We have the following equations for determining x, y, x', y' :—

					Residuals s
+ 1·000x	0·000y + 1·000x'	0·000y' − 0·451 = 0	−0·020
+ ·966x +	·259y + ·866x' +	·500y' − 0·368 = 0	−0·007
+ ·866x +	·500y + ·500x' +	·866y' − 0·241 = 0	+0·014
+ ·707x +	·707y ·000x' +	1·000y' − 0·117 = 0	+0·006
+ ·500x +	·866y − ·500x' +	·866y' + 0·034 = 0	+0·005
+ ·259x +	·966y − ·866x' +	·500y' + 0·194 = 0	+0·010
·000x +	1·000y − 1·000x'	·000y' + 0·313 = 0	−0·014
− ·259x +	·966y − ·866x' −	·500y' + 0·437 = 0	−0·005
− ·500x +	·866y − ·500x' −	·866y' + 0·509 = 0	−0·008
− ·707x +	·707y ·000x' −	1·000y' + 0·536 = 0	−0·009
− ·866x +	·500y + ·500x' −	·866y' + 0·527 = 0	0·000
− ·966x +	·259y + ·866x' −	·500y' + 0·506 = 0	+0·029
− 1·000x	·000y + 1·000x'	·000y' + 0·385 = 0	+0·010
− ·966x −	·259y + ·866x' +	·500y' + 0·244 = 0	−0·019
− ·866x −	·500y + ·500x' +	·866y' + 0·127 = 0	−0·016
− ·707x −	·707y ·000x' +	1·000y' + 0·014 = 0	−0·011
− ·500x −	·866y − ·500x' +	·866y' − 0·075 = 0	+0·010
− ·259x −	·966y − ·866x' +	·500y' − 0·180 = 0	+0·006
·000x −	1·000y − 1·000x'	·000y' − 0·262 = 0	+0·009
+ ·259x −	·966y − ·866x' −	·500y' − 0·345 = 0	−0·001
+ ·500x −	·866y − ·500x' −	·866y − 0·408 = 0	−0·003
+ ·707x −	·707y ·000x' −	1·000y' − 0·446 = 0	+0·001
+ ·866x −	·500y + ·500x' −	·866y' − 0·474 = 0	−0·003
+ ·966x −	·259y + ·866x' −	·500y' − 0·453 = 0	+0·012

The normals from these are :—

12·000x − 4·835 = 0. 12·000x' − 0·330 = 0.

12·000y + 3·586 = 0. 12·000y' − 0·589 = 0.

whence

$$x = +0^{s}\cdot403 \quad y = -0^{s}\cdot299 \quad x' = +0^{s}\cdot028 \quad y' = +0^{s}\cdot049.$$

The last column gives the residuals found by substituting these values of x, y, x' and y' in the equations.

The representation of the observed values is very satisfactory, and the mean level errors will be closely represented by the expression

$$L = -1^{s}\cdot031 + 0^{s}\cdot502 \sin(\odot + 126^{\circ}\,34') + 0^{s}\cdot056 \sin(2\odot + 29^{\circ}\,16').$$

The western pivot is therefore at its lowest relative position about May 19, and at its highest about December 6—the difference between the two heights being approximately $\frac{5}{1000}$ of an inch.

Table IV. gives the mean monthly temperature of the air for the same years, derived from the readings of the thermometer in the window crib attached to the south wall of the Transit Circle room (unfortunately there are no deep-sunk earth thermometers at the Observatory). This thermometer, owing to the circumstances of its exposure, does not give quite the true temperature of the air on very hot or very cold days, but in the mean of a large number of days the results from it agree fairly well with those obtained from thermometers with better exposures; while it possesses the merit of giving a continuous series of observations made under the same circumstances from 1859 to the present time.

Digitized by Google

For the years 1856 to 1870 these mean temperatures are taken from the "Results of Meteorological Observations," published by Mr. Stone†; for 1871 to 1882 from the results published by the Cape Meteorological Commission and from the Observatory Records, with the application of the corrections depending on the hours of observation and given on page [2] of Mr. Stone's work.

If we suppose these monthly means to represent the temperatures at the middle of the months (a supposition not perfectly correct, but sufficiently so for present purposes) we can represent them by the expression :—

$$T = 61^{\circ}\cdot32 + 7^{\circ}\cdot25 \sin(\odot + 67^{\circ}\ 59') + 0^{\circ}\cdot60 \sin(2\odot - 11^{\circ}\ 57').$$

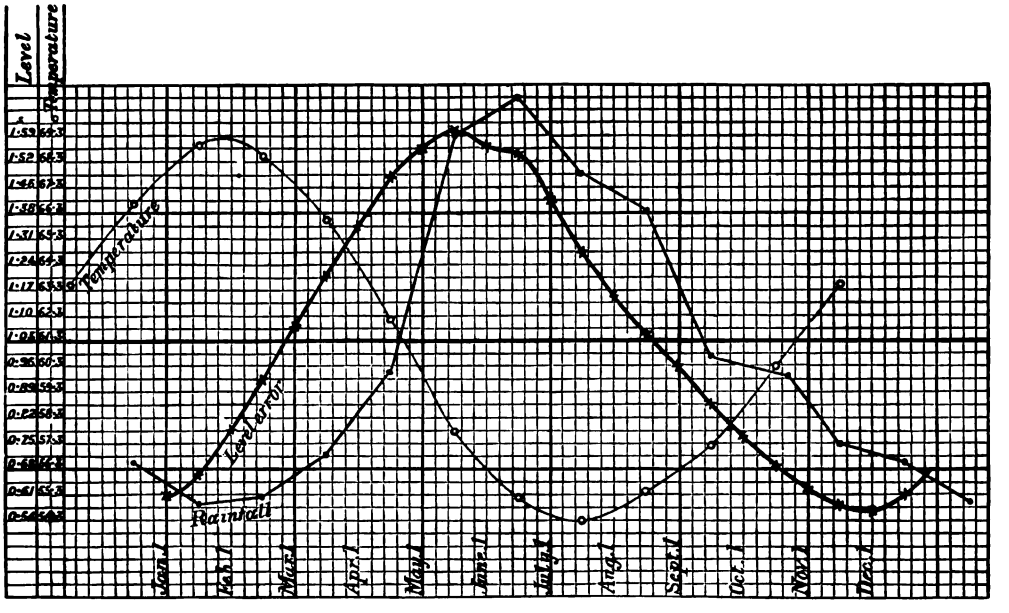
The differences between the values computed from this expression and the observed means are :—

	°		°		°		°
Jan.	+0·15	Apr.	+0·18	July	−0·07	Oct.	+0·08
Feb.	−0·12	May	−0·12	Aug.	+0·13	Nov.	−0·05
Mar.	−0·06	June	+0·04	Sept.	−0·11	Dec.	−0·04

Table V. gives the monthly rain-fall for the same years.

If now we draw the curves representing the level errors and the temperatures on such a scale that the amplitudes of the two curves are nearly the same, *i.e.*, so that a change of 7°·25 in temperature corresponds to a change of 0ˢ·502 nearly in level, we get the following figure :—

FIG. 1.



† Results of Meteorological Observations made at the Royal Observatory, Cape of Good Hope. Cape Town, 1871.

Digitized by Google

The similarity of the two curves is very striking, and shows that the changes of level during the year are certainly chiefly due to the changes of temperature, but that an interval of about *four months* elapses before the effects of the temperature are visible in the level. Thus a rise of 1° in the mean monthly temperature causes a relative fall four months afterwards of the western pivot of $\frac{1}{3000}$ of an inch.

These fluctuations of the level may be due to an actual motion of the top of the hill, caused by the unequal action of the sun on its eastern and western sides—unequal owing to the eastern side being shaded by trees—such action taking effect in a stratum at such a depth below the surface that the heat of summer takes four months to reach it; or, they may be due to unequal expansions of the piers. In the former case we should expect the excess of expansion to be on the western side, which would give changes of level in the opposite direction to those observed. The piers, for the most part, are built with the same kind of stone, and the expansion of the two should be nearly the same; but the explanation of the observed effects of temperature may perhaps be found in the large 11-ton block which forms the first course of the West Pier. Changes of temperature will take longer to force their way through this block than through the smaller ones of the East Pier, which are surrounded by a number of channels through which air might penetrate*, and consequently the expansion of the West Pier will lag behind that of the East one.

A curve drawn through the ends of ordinates representing the monthly rain-fall is also somewhat similar to the level curve, but the points of difference are sufficient to justify the conclusion that the change of temperature is the chief determining cause. Thus, the sudden increase of rain in May and June agrees well with the fall of the level curve in June; but, while the rain-fall has reached its average amount in September, the level curve continues to fall till the middle of December; and again, the level curve mounts steadily through March and April although the rain-fall is three times as much then as in January or February.

On page [22] of the "Meteorological Results" Mr. Stone points out that there is a marked correspondence between the rain-fall curve and the inverse curve of temperature; so that, considering the amount of similarity existing between the rain-fall and the level error, it might seem that the inverse curve of temperature should have been drawn in my figure above. But it will be seen that if the inverse curve be drawn the temperature *follows* the level by about two months, which certainly seems to be reversing the natural order of things.

There is, however, an effect of the rain-fall apparent when we examine the separate years. It will be found from a comparison of Tables I. and IV. that a fall of rain above the average occurring in January, February, or March has no appreciable effect on the level, but that the first heavy rain between May and July determines the turning point of the curve. The level seems on the balance, as it were, about this latter time, and the rain-

* Sir T. Maclear expressly states that the cement was spread very thinly—just sufficient to fill up the holes left by the dressing of the stone.

Digitized by Google

fall is able to affect it, and cause it to turn before it otherwise would have done. For example we have rain-fall above the average on the following occasions :—

1859 January	No effect on level.
1863 March	Do. Do.
1866 February	Slight hesitation in level.
1874 April...	No effect on level.
1877 April...	Do. Do.
1880 January	Do. Do.
1881 April...	Slight hesitation in level.
1882 March	No effect on level.

1862 June	Level turns.
1866 June	Do.
1869 May	Do.
1872 May	Level steady—turns in June.
1875 June	Level turns.
1877 May	Do.
1878 May	Do.
1881 May	Level turns, but goes back again.

In 1879 and 1880 the rain-fall in May, June, and July is considerably below the average, and the level does not turn till the end of July in the one year, and the end of August in the other.

The effect of this can also be traced in Fig. 1. It will be seen there that while the difference in time between the highest points of the two curves is 4 months, it is $4\frac{1}{2}$ months between their lowest points.

AZIMUTHS.

Table II. gives the semi-monthly values of the Azimuth error, formed as in the case of the levels. There are several gaps in this series where there have been no determinations of Azimuth about the first or the fifteenth of the month, and these have been filled up conjecturally from the general run of adjoining numbers: these values are distinguished by being enclosed in brackets.

If the semi-monthly means are treated as in the case of the levels, we find the following expression for them :—

$$Z = +\,0^s{\cdot}584 + 0^s{\cdot}156 \sin(\odot + 43^\circ\,25') + 0^s{\cdot}089 \sin(2\odot - 18^\circ\,14')$$

and the discordances between the values computed from this formula and the observed means are :—

	s		s		s		s
Jan. 1	+0·02	Apr. 1	−0·01	July 1	0·00	Oct. 1	0·00
15	− ·02	15	·00	15	− ·03	15	− ·03
Feb. 1	− ·05	May 1	− ·02	Aug. 1	·00	Nov. 1	− ·01
15	− ·01	15	− ·01	15	+ ·01	15	·00
Mar. 1	+ ·04	June 1	+ ·02	Sept. 1	+ ·02	Dec. 1	+ ·01
15	+ ·04	15	+ ·02	15	·00	15	+ ·01

But these mean values do not give a fair representation of the real variations during the year, for it will be noticed that the time of the maximum Azimuth changes through the series, coming gradually earlier and earlier, so that the period of the Azimuth error seems

Digitized by Google

to be something less than a year—in fact about $11\frac{3}{4}$ months. The tendency of this is of course to equalize the means taken as in the table, and to conceal the range of the actual fluctuations.

NADIRS.

The semi-monthly values of the Nadir-point readings are given in Table III. There is a gap in this series which I have not found it possible to allow for. Observations were discontinued in May 1879, and the microscope-micrometers were afterwards sent to England for alterations (Cf. Introduction to the Cape Observations, 1879-1881). They were not re-mounted till March 1880, when a general re-adjustment of the whole instrument took place, and it is not possible to connect the subsequent Nadirs with the previous ones. With this exception account has been carefully taken of all changes introduced by adjustments of the microscopes or the declination micrometer, and the necessary corrections have been applied to all subsequent readings to reduce them to a uniform system.

The formula representing the semi-monthly means for the years 1856-1878 is :—

$$N = 65''{\cdot}86 + 4''{\cdot}28 \sin (\odot + 6^\circ\ 58') + 1''{\cdot}73 \sin (2\odot - 31^\circ\ 56').$$

and the discordances between the computed and observed quantities are :—

Jan. 1	+0·21	Apr. 1	−0·12	July 1	−6·03	Oct. 1	−0·02
15	+0·06	15	−0·36	15	−0·84	15	−0·22
Feb. 1	−0·58	May 1	−0·10	Aug. 1	−0·14	Nov. 1	−0·34
15	+0·10	15	+0·12	15	+0·16	15	−0·14
Mar. 1	+0·26	June 1	+0·78	Sept. 1	−0·48	Dec. 1	−0·08
15	+0·18	15	+0·38	15	+0·50	15	+0·28

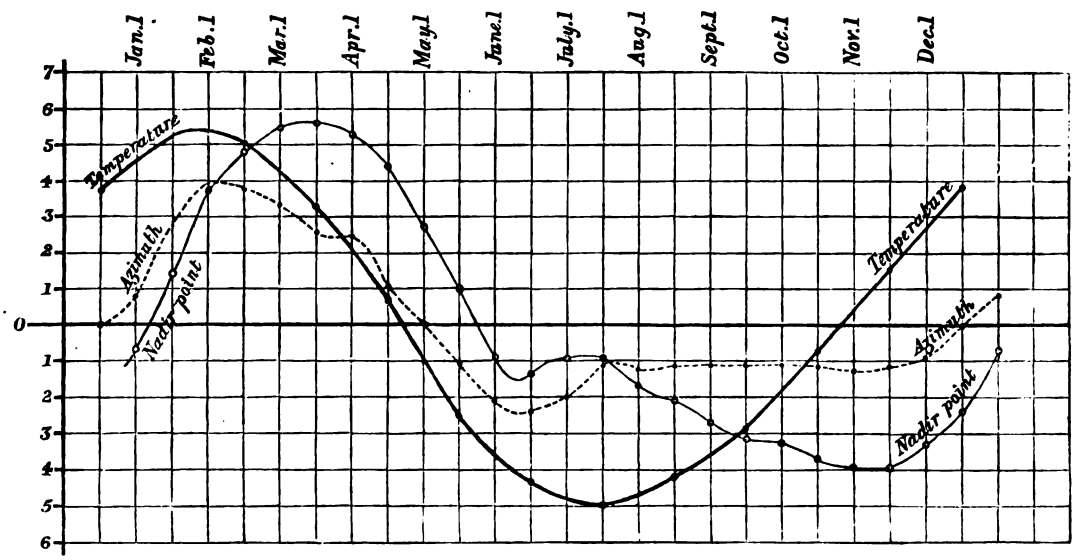
But in this case, again, there is an acceleration in the time of maximum value similar to that observed in the Azimuths, and of the same amount. The variations of the two adjustments, Azimuth error and Nadir-point reading, are evidently closely connected. They reach their maximum values within a month of each other in nearly every year; heavy winter rains cause a sudden increase in both at very nearly the same time: in both cases the greater discordances from the mean are confined to the first half of the year, and there is a general similarity in their variations in the several years.

The figure on the opposite page gives the curves representing the mean Azimuths, Nadir-point readings, and Temperatures.

Digitized by Google

The curves of Azimuth and Nadir-point agree fairly well with the temperature if we suppose the rise about June, and the retardation of the time of minimum to be due to the rain fall. Much stress cannot, however, be laid on this agreement so long as the apparent period of about $11\frac{3}{4}$ months remains unexplained; the present form of the curves being chiefly due to the larger range of fluctuation in the middle years of the series.

Fig. 2.



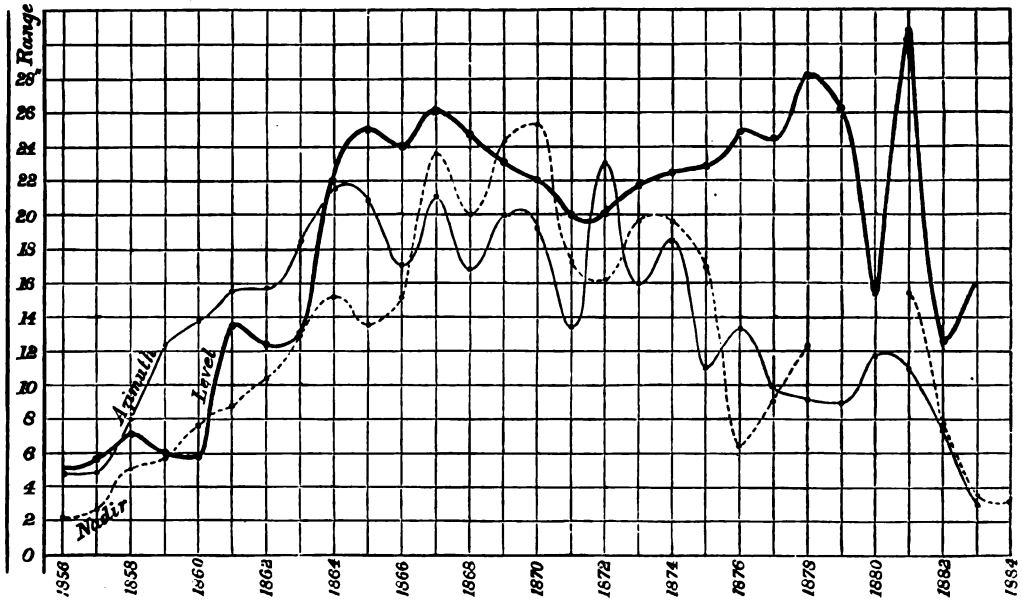
RANGE OF FLUCTUATION IN A YEAR.

The amount of the annual fluctuation does not by any means remain the same in different years. The "range" in the level, for example, is much larger in 1862 than in former years, and from 1864 onwards. To account for this increase of range the not improbable supposition was advanced by Mr. Stone that the position of the Transit Circle is influenced by the amount of back-water in the rivers around the hill upon which the Observatory stands. This must be taken to refer to the overflowing of these rivers, and the accumulation of rain on the low ground to the north and north-east of the hill during heavy winter rains. I have made numerous enquiries about this accumulation of water from residents who remember the ground before the railway embankment was made, and the general impression is that there has not been any marked increase in the amount in consequence of the embankment; and, in fact, the main road to the country runs roughly parallel to the railway at a distance of about 100 yards beyond it, and would previously have had nearly the same effect on the water that the embankment now has. This embankment was completed in 1860 and the regular train service began in 1862. It is worth noting that there was a most unusually heavy fall of rain in June, 1862.

Digitized by Google

To throw further light on this point I have formed tables of annual ranges, by taking the difference between the minimum value in each year, and the mean of the two maxima between which it lies as the range in the year; and with these ranges as ordinates the following curves are obtained :—

FIG. 3.



There is apparently a periodicity in the range of the Azimuth and Nadir-point variations which is extremely curious, and for which I am unable to suggest any explanation at present: the annual ranges at these two bear considerable likeness to one another, and point once more to an intimate connection between the changes of Azimuth and of Nadir-point reading. As far as these two adjustments are concerned the curves do not support the theory that there are increased ranges from 1864 onwards due to the accumulation of back-water in the rivers: the range of the level, however, is certainly much larger after 1864, and this increase may be due to some such cause.

III.

CHANGES FROM YEAR TO YEAR.

The last column in the Tables gives the means of the semi-monthly values of the adjustments for each year, and these may be considered the mean value of the year. They are represented in the following figures (the scale is not the same in both figures) :—

Digitized by Google

FIG. 4.

(Level.)

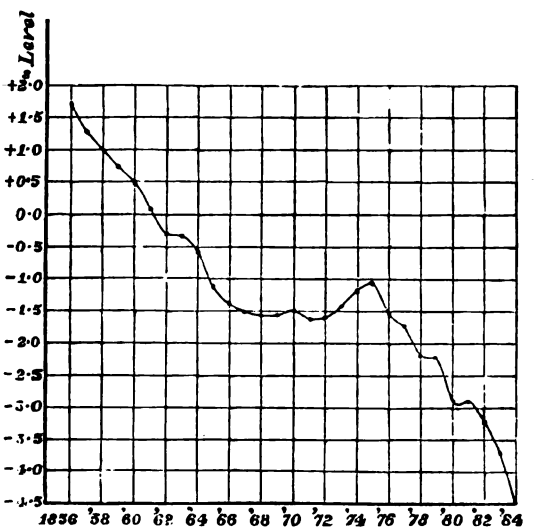
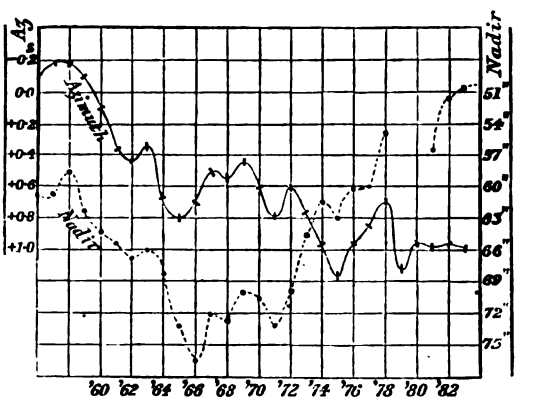


FIG. 5.

(Az. and Nadir.)



It is at once evident from a consideration of Fig. 4 that the level error is affected by a steady yearly decrease combined with a periodic term of from 17 to 20 years' period.

I assume that the mean value of the level for any year can be expressed by the formula :

$$L_n = a + \kappa n + A \sin\left(\frac{2n\pi}{q} + \lambda\right) + B \sin\left(\frac{4n\pi}{q} + \mu\right) + C \sin\left(\frac{6n\pi}{q} + \nu\right)$$

where n = the number of years counted from 1869 (negative when counted backwards),

κ = the constant annual increase of level error

$q, \frac{q}{2}, \frac{q}{3}$ = the number of years in the several periods, and a, A, B, C, λ, μ, ν, κ are constants to be determined.

Each yearly mean then gives an equation of the above form ; so that by assuming a value for q we have 27 equations for determining the 8 constants.

I first neglected the last two terms of the formula, as they will evidently not have large co-efficients, and assumed q equal to 17, 18, 19 and 20 successively. The solution of the 27 equations by the method of least squares then led to the following sums of the squares of the residuals in the four cases :—

	$q=17$	$q=18$	$q=19$	$q=20$
$\Sigma v^2 =$	1·0051	0·7130	0·6253	1·3533

Digitized by Google

These values of Σv^2 point to a value of q about 18·5. I then solved the equations including the second periodic term this time, for the values 18·0, 18·4, 18·6 and 19·0 of q. The values of Σv^2 for these solutions are :

	$q=18{\cdot}0$	$q=18{\cdot}4$	$q=18{\cdot}6$	$q=19{\cdot}0$
$\Sigma v^2 =$	0·5587	0·4516	0·4755	0·6080

Finally with the value $q=18{\cdot}4$ I solved the equations again, including the last term $+ C \sin\left(\frac{6n\pi}{q} + \nu\right)$.

Putting the formula in the equivalent form :—

$$L_n = a + \kappa n + x \cos\frac{2n\pi}{q} + y \sin\frac{2n\pi}{q} + x' \cos\frac{4n\pi}{q} + y' \sin\frac{4n\pi}{q} + x'' \cos\frac{6n\pi}{q} + y'' \sin\frac{6n\pi}{q}$$

the equations for this value are :—

									v
a	$-13n$	$-\cdot270x$	$+\cdot963y$	$-\cdot854x'$	$-\cdot520y'$	$+\cdot731x''$	$-\cdot682y''$	$-1{\cdot}71 = 0$	$-0{\cdot}19$
a	$-12n$	$-\cdot577x$	$+\cdot817y$	$-\cdot335x'$	$-\cdot942y'$	$+\cdot963x''$	$+\cdot270y''$	$-1{\cdot}27 = 0$	$+0{\cdot}15$
a	$-11n$	$-\cdot817x$	$+\cdot577y$	$+\cdot335x'$	$-\cdot942y'$	$+\cdot270x''$	$+\cdot963y''$	$-1{\cdot}00 = 0$	$+0{\cdot}14$
a	$-10n$	$-\cdot995x$	$+\cdot098y$	$+\cdot854x'$	$-\cdot520y'$	$-\cdot683x''$	$+\cdot731y''$	$-0{\cdot}72 = 0$	$-0{\cdot}04$
a	$-9n$	$-\cdot998x$	$-\cdot068y$	$+\cdot991x'$	$+\cdot136y'$	$-\cdot979x''$	$-\cdot203y''$	$-0{\cdot}50 = 0$	$-0{\cdot}10$
a	$-8n$	$-\cdot917x$	$-\cdot398y$	$+\cdot683x'$	$+\cdot731y'$	$-\cdot335x''$	$-\cdot942y''$	$-0{\cdot}15 = 0$	$-0{\cdot}02$
a	$-7n$	$-\cdot731x$	$-\cdot682y$	$+\cdot068x'$	$+\cdot998y'$	$+\cdot631x''$	$-\cdot776y''$	$+0{\cdot}30 = 0$	$+0{\cdot}20$
a	$-6n$	$-\cdot460x$	$-\cdot888y$	$-\cdot577x'$	$+\cdot817y'$	$+\cdot991x''$	$+\cdot136y''$	$+0{\cdot}28 = 0$	$-0{\cdot}10$
a	$-5n$	$-\cdot136x$	$-\cdot991y$	$-\cdot995x'$	$+\cdot098y'$	$+\cdot398x''$	$+\cdot917y''$	$+0{\cdot}58 = 0$	$-0{\cdot}15$
a	$-4n$	$+\cdot203x$	$-\cdot979y$	$-\cdot917x'$	$-\cdot398y'$	$-\cdot577x''$	$+\cdot817y''$	$+1{\cdot}19 = 0$	$+0{\cdot}09$
a	$-3n$	$+\cdot519x$	$-\cdot855y$	$-\cdot460x'$	$-\cdot888y'$	$-\cdot998x''$	$-\cdot068y''$	$+1{\cdot}34 = 0$	$-0{\cdot}02$
a	$-2n$	$+\cdot776x$	$-\cdot631y$	$+\cdot203x'$	$-\cdot979y'$	$-\cdot460x''$	$-\cdot888y''$	$+1{\cdot}54 = 0$	$+0{\cdot}05$
a	$-n$	$+\cdot942x$	$-\cdot335y$	$+\cdot776x'$	$-\cdot631y'$	$+\cdot519x''$	$-\cdot855y''$	$+1{\cdot}55 = 0$	$+0{\cdot}03$
a		$+1{\cdot}000x$		$+1{\cdot}000x'$		$+1{\cdot}000x''$		$+1{\cdot}53 = 0$	$-0{\cdot}02$
a	$+n$	$+\cdot942x$	$+\cdot335y$	$+\cdot776x'$	$+\cdot631y'$	$+\cdot519x''$	$+\cdot855y''$	$+1{\cdot}47 = 0$	$-0{\cdot}12$
a	$+2n$	$+\cdot776x$	$+\cdot631y$	$+\cdot203x'$	$+\cdot979y'$	$-\cdot460x''$	$+\cdot888y''$	$+1{\cdot}64 = 0$	$+0{\cdot}04$
a	$+3n$	$+\cdot519x$	$+\cdot855y$	$-\cdot460x'$	$+\cdot888y'$	$-\cdot998x''$	$+\cdot068y''$	$+1{\cdot}57 = 0$	$+0{\cdot}06$
a	$+4n$	$+\cdot203x$	$+\cdot979y$	$-\cdot917x'$	$+\cdot398y'$	$-\cdot577x''$	$-\cdot817y''$	$+1{\cdot}40 = 0$	$+0{\cdot}06$
a	$+5n$	$-\cdot136x$	$+\cdot991y$	$-\cdot995x'$	$-\cdot098y'$	$+\cdot398x''$	$-\cdot917y''$	$+1{\cdot}19 = 0$	$0{\cdot}00$
a	$+6n$	$-\cdot460x$	$+\cdot888y$	$-\cdot577x'$	$-\cdot817y'$	$+\cdot991x''$	$-\cdot136y''$	$+1{\cdot}09 = 0$	$-0{\cdot}10$
a	$+7n$	$-\cdot731x$	$+\cdot682y$	$+\cdot068x'$	$-\cdot998y'$	$+\cdot631x''$	$+\cdot776y''$	$+1{\cdot}52 = 0$	$+0{\cdot}11$
a	$+8n$	$-\cdot917x$	$+\cdot398y$	$+\cdot683x'$	$-\cdot731y'$	$-\cdot335x''$	$+\cdot942y''$	$+1{\cdot}67 = 0$	$-0{\cdot}12$
a	$+9n$	$-\cdot998x$	$+\cdot068y$	$+\cdot991x'$	$-\cdot136y'$	$-\cdot979x''$	$+\cdot203y''$	$+2{\cdot}21 = 0$	$+0{\cdot}05$
a	$+10n$	$-\cdot995x$	$-\cdot098y$	$+\cdot854x'$	$+\cdot520y'$	$-\cdot683x''$	$-\cdot731y''$	$+2{\cdot}19 = 0$	$-0{\cdot}17$
a	$+11n$	$-\cdot817x$	$-\cdot577y$	$+\cdot335x'$	$+\cdot942y'$	$+\cdot270x''$	$-\cdot963y''$	$+2{\cdot}88 = 0$	$+0{\cdot}20$
a	$+12n$	$-\cdot577x$	$-\cdot817y$	$-\cdot335x'$	$+\cdot942y'$	$+\cdot963x''$	$-\cdot270y''$	$+2{\cdot}88 = 0$	$-0{\cdot}07$
a	$+13n$	$-\cdot270x$	$-\cdot963y$	$-\cdot854x'$	$+\cdot520y'$	$+\cdot731x''$	$+\cdot682y''$	$+3{\cdot}26 = 0$	$-0{\cdot}01$

The normals from these are :—

$+27{\cdot}000a$	$-5{\cdot}922x$	$+0{\cdot}544x'$	$+1{\cdot}942x''$	$+27{\cdot}930 = 0$
$+1638{\cdot}0\kappa$	$-5{\cdot}438y$	$+42{\cdot}042y'$	$-6{\cdot}632y''$	$+243{\cdot}240 = 0$
$-5{\cdot}922a$	$+13{\cdot}928x$	$-2{\cdot}002x'$	$-0{\cdot}032x''$	$-0{\cdot}768 = 0$
$-5{\cdot}438\kappa$	$+13{\cdot}070y$	$-3{\cdot}290y'$	$+0{\cdot}684y''$	$-7{\cdot}200 = 0$
$+0{\cdot}544a$	$-2{\cdot}002x$	$+13{\cdot}308x'$	$-3{\cdot}530x''$	$+1{\cdot}132 = 0$
$+42{\cdot}042\kappa$	$-3{\cdot}290y$	$+13{\cdot}684y'$	$-2{\cdot}658y''$	$+8{\cdot}358 = 0$
$+1{\cdot}942a$	$-0{\cdot}032x$	$-3{\cdot}530x'$	$+13{\cdot}834x''$	$+0{\cdot}450 = 0$
$-6{\cdot}632\kappa$	$+0{\cdot}684y$	$-2{\cdot}658y$	$+13{\cdot}162y''$	$-1{\cdot}188 = 0$

Digitized by Google

the solution of which leads to the values :—

$$a=-1^{s}\cdot1369, \quad x=-0\cdot4390, \quad x'=-0\cdot0764, \quad x''=+0\cdot1066,$$
$$\kappa=-0\cdot1457, \quad y=+0\cdot4781, \quad y'=-0\cdot0519, \quad y''=-0\cdot0184,$$

and the formula therefore is :—

$$L_n=-1^{s}\cdot137-0^{s}\cdot146n+0^{s}\cdot649\sin\left(\frac{2n\pi}{18\cdot4}-42^{\circ}\,34'\right)+0^{s}\cdot092\sin\left(\frac{4n\pi}{18\cdot4}+235^{\circ}\,47\right)$$
$$+0^{s}\cdot108\sin\left(\frac{6n\pi}{18\cdot4}+99^{\circ}\,49'\right).$$

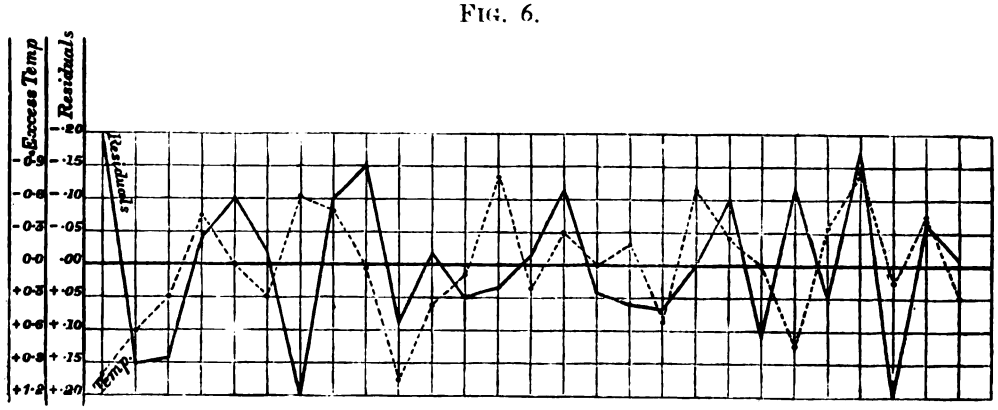
The last column in the preceding table of equations gives the differences between the levels computed from this formula and the observed values. The sum of the squares of these residuals is 0·3111, and the probable error therefore of any computed value is $\pm0^{s}\cdot074$.

The formula gives a good representation of the mean annual values, and there seems to be no doubt of the existence of a periodicity of between 18 and 19 years in the level of the Transit-circle, so far at least as these 27 years are concerned.

The observations of 1883 and 1884 are now available and will serve as a check : the values of the mean levels for these years computed from the formula are $-3^{s}\cdot65$ and $-3^{s}\cdot95$, while the observed values are $-3^{s}\cdot68$ and $-4^{s}\cdot45$. The agreement is very satisfactory for 1883, but far from being so for 1884. The observed decrease, however, between these two years is larger than between any other two of the series, and the level reaches its greatest negative value much earlier than in any other year: so that it would almost seem that some abnormal factor had been at work, but any decision on this point must be left till further observations are available.

There is one point which has not been taken into consideration in the preceding solution, viz., the fact that the mean annual temperature is not the same for each of these years : and as the changes of temperature were found to be the chief cause of the annual fluctuations it is only reasonable to expect that an increase of the mean annual temperature will be followed by a corresponding change in the mean annual level. In Fig. 6, therefore, I have plotted the residuals found in the foregoing solution and the excesses of the mean temperature in each year over the mean of all.

FIG. 6.



Digitized by Google

There is a slight amount of similarity between the curves, but it is scarcely sufficient to justify a statement that the residuals can be accounted for by the excess of temperature in the year or the year before.

AZIMUTH.

See Fig. 5. These 27 years seem to form part of a period of considerable length, and are insufficient to determine it with accuracy. Combined with this long period there are two shorter ones of ten years and five years respectively.

I have tried several values for the long period and find that one of about 54 years, either with or without a constant annual increase of Azimuth, gives a very fair representation of the observed values. The solution with a constant increase gives smaller residuals on the whole, but it runs away rapidly from the results obtained in 1883 and 1884, and, therefore, I reject it. Proceeding as in the case of the levels I find the formula :—

$$Z_n = +\,0^s{\cdot}468 + 0^s{\cdot}523 \sin\left(\frac{2n\pi}{54} + 26^\circ\,56'\right) + 0^s{\cdot}147 \sin\left(\frac{2n\pi}{10} - 86^\circ\,52'\right) + 0^s{\cdot}114 \sin\left(\frac{2n\pi}{5} + 12^\circ\,15'\right)$$

The differences between the values computed from this formula and the observed ones are :—

	s		s		s		s
1856	+0·18	1863	+0·03	1870	+0·11	1877	−0·05
1857	+0·10	1864	−0·14	1871	0·00	1878	+0·06
1858	+0·03	1865	−0·11	1872	+0·21	1879	−0·27
1859	+0·11	1866	−0·12	1873	+0·14	1880	+0·02
1860	+0·07	1867	−0·05	1874	+0·12	1881	−0·01
1861	−0·11	1868	−0·14	1875	−0·01	1882	−0·05
1862	−0·22	1869	−0·08	1876	+0·09		

and the probable error of any computed value $= \pm 0^s{\cdot}081$. The run of the signs in the residuals is hardly satisfactory, and a better representation could probably be obtained by slightly changing the periods, but it scarcely seems worth while pursuing the matter further until more observations are available. The values for 1883 and 1884 derived from the formula are $+\,0^s{\cdot}95$ and $+\,1^s{\cdot}06$ respectively, while the observed values are $+0^s{\cdot}99$ and $+0^s{\cdot}99$.

NADIRS.

See Fig. 5. The series of years available for a discussion of the Nadir-point readings only extends to 1878.

It is somewhat disappointing, considering the connection previously found between the fluctuations of the Azimuth and Nadir-point reading, to see that these yearly values do not follow the same law as those of Azimuth. The two curves are very similar till 1872 (the adjustment of the level was made in this year, and a change of $0^s{\cdot}3$ seems to have

Digitized by Google

been caused in the Azimuth, and has been allowed for in tabulating subsequent values), but after that they separate. After trying several values for the main period I have finally been led to one of about 27 years, with a subordinate period of $5\frac{1}{2}$ years. The formula for this solution (n being reckoned from the year 1867) is :—

$$N_n = 64''\cdot49 - 0''\cdot40n + 8''\cdot75 \sin\left(\frac{2n\pi}{27} + 68^\circ\,3'\right) + 1''\cdot73 \sin\left(\frac{2n\pi}{5\frac{1}{2}} + 159^\circ\,42'\right)$$

The differences between the computed and observed values are :—

	″		″		″		″
1856	+0·2	1862	−0·7	1868	−1·2	1874	+0·8
1857	−1·7	1863	+0·8	1869	+0·8	1875	−1·9
1858	+0·9	1864	+0·9	1870	+0·8	1876	+0·2
1859	−0·1	1865	−1·2	1871	−2·2	1877	−1·0
1860	+0·8	1866	−2·6	1872	+0·3	1878	+0·6
1861	+1·0	1867	+1·4	1873	+1·8		

and the probable error of any computed value $= \pm 0''\cdot84$.

The conclusions, then, that I draw from the results of this investigation are :—

(1.) The fluctuations of the level error of the Transit-circle in the course of the year are caused by the changes of temperature causing a slight motion of the hill, the effect following the cause by an interval of $4\frac{1}{2}$ months. The first *heavy* rain between May and August causes the level to turn, but does not sensibly affect the range of fluctuation; at other times of the year the rain is without effect. An excessive rain probably forces its way through crevices to the strata acted on, and, being low in temperature in winter, hastens to counteract the effect of the summer heat which has by this time reached the st rata.

(2.) The fluctuations in Azimuth error and Nadir-point reading are closely connected, and follow a period of $11\frac{3}{4}$ months rather than a year. As far, however, as this series goes they are fairly accounted for by considering them to be due to the changes of temperature and the rain-fall combined, rain and fall of temperature acting on them in opposite directions.

(3.) The mean annual values of the level error follow a period of about $18\frac{1}{2}$ years, which must be due to a motion of the hill (possibly of the whole mountain range forming the Cape Peninsula).

(4.) The mean annual values of Azimuth error and Nadir-point reading follow longer and more uncertain periods. Approximations to these are 54 years for the Azimuth, and 27 for the Nadir Point.

It would be very interesting to compare the changes in the adjustments of the old Transit, which is 52 feet to the west of the Transit-circle, but this is quite impossible in the case of the Azimuth. Every time the instrument was reversed the middle wire was

Digitized by Google

brought nearly into coincidence with the collimating mark by means of the adjusting screws, and no record was kept of the amount of alteration made in the Azimuth. The case of the level is not so bad; there are long intervals occasionally without any determination, and then adjustments have been made without any data being given to fix the exact amount of alteration introduced, but still it is possible to get a very fair idea of the general run of the level error. Table VI. gives monthly average values of the level error of the Transit from 1834 to 1854, which I have compiled from the old records and reduced, so far as can be done, to a uniform system. The means for the different months and for the different years are plotted in Figs. 7 and 8.

FIG. 7.

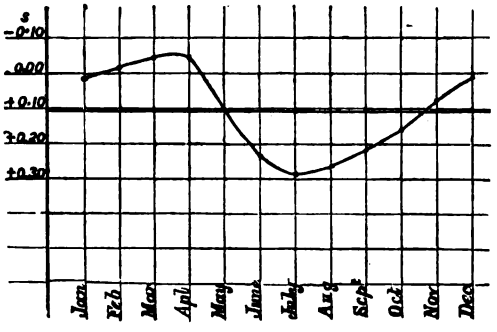
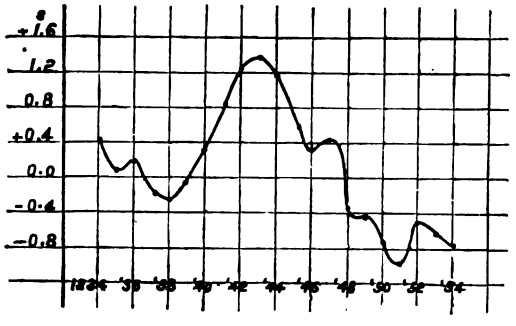


FIG. 8.



The curve of monthly variation bears some resemblance to that found for the Transit-circle, the largest negative value occurring between March and April and the largest positive in July. These values occur sooner than the corresponding ones for the Transit-circle, and thus afford a confirmation of my supposition that the large 11-ton block in the west pier of the latter instrument causes a lagging in the expansion of that pier. The main point of difference between the two curves is the rapid fall in that of the old Transit and its shorter duration: this points to the conclusion that the rain-fall has more to do with these fluctuations than the temperature.

The curve of the yearly means shews a variation similar in character to the 18½-year period found for the Transit-circle, but the cessation of observations in 1855, and the uncertainty of some of the corrections applied in Table VI., prevent any definite conclusion as to the agreement of the periods in length: the highest point of the curve, however, is not reached in the year it should be according to the formula for the Transit-circle.

It may be worth while comparing the levels of the Cape Transit-circle with those of its sister-instrument at Greenwich. Table VII. gives semi-monthly values of the level error at Greenwich for the years 1851-1881, compiled from the annual volumes of observations and corrected for any arbitrary adjustments effected.

Digitized by Google

The Greenwich fluctuations are *very* much smaller but are well marked: they are represented in Figs. 9 and 10.

FIG. 9.

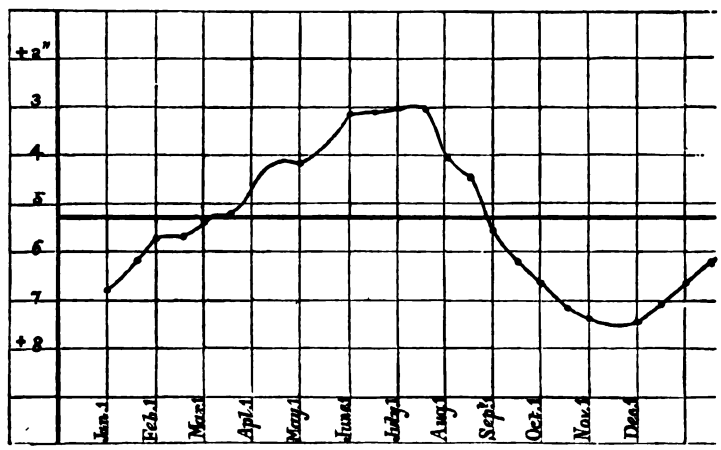
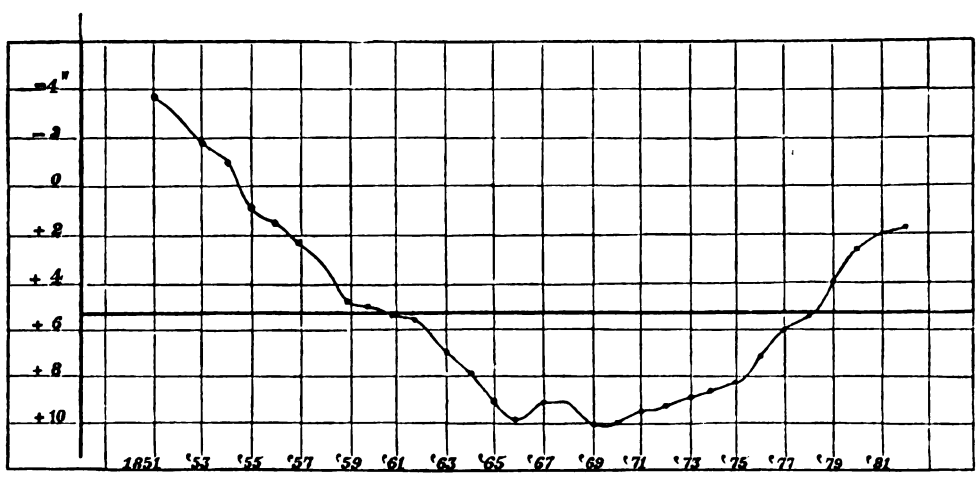


FIG. 10.



The curve of monthly variations shews a general agreement with the temperature: the highest point occurs about July; the curve then falls suddenly and reaches its lowest point in the middle of November, two months before the time of minimum temperature. In Volume xxix. of the Memoirs of the Royal Astronomical Society there is a paper by Mr. Ellis on the periodical variations in level and azimuth of the Greenwich Transit-circle, in which he discusses the observations from 1851 to 1858. In considering the effects of the more rapid variations of the temperature of the atmosphere on the level, he states that "comparisons of suitable observations seem to shew that an increase of 10° of mean daily external temperature cause a decrease of level, or rather a rise of the east pivot, amounting

Digitized by Google

to about 1″·00 below 50°, and about 1″·50 above 50°." Were it not for this statement I should be inclined to invert the curve in Fig. 9, and say that the level error curve *follows* the temperature by an interval of from four to five months.

The mean semi-monthly values are closely represented by the expression

$$+ 5''{\cdot}36 + 2''{\cdot}01 \sin (\odot + 119^\circ\, 40') + 0''{\cdot}52 \sin (2 \odot + 239^\circ\, 53').$$

The mean annual values evidently follow a well-marked period of considerable length, but I have not attempted to determine its period.

W. H. FINLAY.

ROYAL OBSERVATORY,
CAPE OF GOOD HOPE,
1885 *June*.

Digitized by Google

Digitized by Google

TABLE

LEVEL ERRORS OF THE CL

Year.	Jan. 1.	Jan. 15.	Feb. 1.	Feb. 15.	Mar. 1.	Mar. 15.	Apr. 1.	Apr. 15.	May 1.	May 15.	June 1.	June 15.	July.
	s	s	s	s	s	s	s	s	s	s	s	s	s
1856	+2·14	+2·13	+2·07	+2·02	+2·02	+1·96	+1·96	+1·94	+1·86	+1·82	+1·56	+1·56	+1·5
1857	+1·50	+1·55	+1·55	+1·55	+1·52	+1·46	+1·40	+1·40	+1·30	+1·37	+1·22	+1·10	+1·1
1858	+1·25	+1·25	+1·20	+1·27	+1·18	+1·18	+1·18	+1·17	+1·16	+1·02	+1·00	+0·97	+0·9
1859	+0·99	+1·01	+1·07	+1·01	+0·96	+0·95	+0·91	+0·89	+0·79	+0·75	+0·70	+0·66	+0·6
1860	+0·76	+0·77	+0·78	+0·77	+0·75	+0·68	+0·58	+0·50	+0·46	+0·40	+0·40	+0·41	+0·4
1861	+0·44	+0·48	+0·48	+0·44	+0·32	+0·20	+0·20	+0·03	−0·13	−0·18	−0·02	0·00	0·0
1862	+0·28	+0·21	+0·17	+0·05	−0·03	−0·20	−0·38	−0·58	−0·76	−0·81	−0·94	−1·00	−0·9
1863	+0·08	+0·06	+0·03	−0·03	−0·22	−0·39	−0·44	−0·47	−0·40	−0·44	−0·40	−0·41	−0·4
1864	−0·02	−0·05	−0·03	−0·10	−0·27	−0·49	−0·60	−0·81	−1·00	−1·20	−1·26	−1·27	−1·2
1865	−0·30	−0·41	−0·60	−0·87	−1·20	−1·50	−1·90	−2·22	−2·15	−2·15	−2·10	−2·00	−1·9
1866	−0·67	−0·88	−1·30	−1·30	−1·20	−1·34	−1·60	−1·95	−2·00	−2·00	−2·10	−2·10	−2·1
1867	−1·10	−1·30	−1·60	−1·70	−2·00	−2·08	−2·39	−2·50	−2·48	−2·30	−2·26	−2·20	−1·9
1868	−0·83	−0·98	−1·21	−1·34	−1·58	−1·84	−2·19	−2·36	−2·28	−2·23	−2·25	−2·37	−2·3
1869	−0·87	−1·02	−1·38	−1·70	−1·89	−2·20	−2·48	−2·41	−2·40	−2·32	−2·18	−1·66	−1·3
1870	−0·90	−1·00	−1·10	−1·38	−1·50	−1·80	−2·01	−2·12	−2·20	−2·20	−2·12	−2·01	−1·9
1871	−1·10	−1·20	−1·50	−1·66	−1·83	−2·00	−2·15	−2·20	−2·29	−2·32	−2·32	−2·32	−2·2
1872	−1·37	−1·55	−1·75	−1·83	−2·00	−2·10	−2·16	−2·22	−2·31	−2·28	−2·07	−1·95	−1·7
1873	−1·00	−1·13	−1·48	−1·70	−1·90	−2·00	−2·01	−2·12	−2·17	−2·13	−2·07	−1·78	−1·5
1874	−0·63	−0·80	−0·95	−1·08	−1·21	−1·38	−1·44	−1·67	−1·80	−1·90	−1·96	−2·04	−1·9
1875	−0·48	−0·51	−0·60	−0·70	−0·86	−1·00	−1·10	−1·31	−1·51	−1·72	−1·81	−1·90	−1·9
1876	−0·63	−0·70	−0·87	−1·17	−1·48	−1·80	−1·70	−1·97	−2·10	−2·22	−2·40	−2·37	−2·2
1877	−1·00	−1·10	−1·21	−1·40	−1·61	−1·80	−2·10	−2·40	−2·62	−2·70	−2·40	−1·91	−1·7
1878	−1·98	−2·18	−2·33	−2·52	−2·73	−2·81	−2·92	−2·94	−3·10	−3·10	−3·00	−3·02	−2·9
1879	−1·20	−1·24	−1·40	−1·60	−2·00	−2·16	−2·47	−2·66	−2·68	−2·63	−2·76	−2·92	−3·0
1880	−1·72	−1·90	−2·03	−2·24	−2·38	−2·55	−2·82	−3·02	−3·20	−3·35	−3·41	−3·40	−3·3
1881	−3·10	−3·22	−3·17	−3·30	−3·32	−3·40	−3·50	−3·60	−3·60	−3·51	−3·71	−3·78	−3·7
1882	−2·30	−2·45	−2·60	−2·75	−3·02	−3·20	−3·27	−3·30	−3·40	−3·56	−3·65	−3·73	−3·7
1883	−3·20	−3·30	−3·36	−3·46	−3·50	−3·58	−3·64	−3·75	−3·82	−3·86	−3·88	−3·96	−3·9
1884	−3·53	−3·66	−3·93	−4·30	−4·57	−4·73	−5·00	−5·00	−4·88	−4·92	−5·00	−4·92	−4·8
Means. 1856 to 1882	−0·510	−0·599	−0·732	−0·862	−1·019	−1·186	−1·311	−1·441	−1·519	−1·552	−1·549	−1·534	−1·4

Digitized by Google

E I.

APE TRANSIT CIRCLE.

1.	July 15.	Aug. 1.	Aug. 15.	Sept. 1.	Sept. 15.	Oct. 1.	Oct. 15.	Nov. 1.	Nov. 15.	Dec. 1.	Dec. 15.	Means.
s	s	s	s	s	s	s	s	s	s	s	s	s
·53	+1·49	+1·49	+1·44	+1·45	+1·51	+1·47	+1·53	+1·54	+1·52	+1·56	+1·49	+1·71
·05	+1·00	+1·05	+1·10	+1·11	+1·10	+1·15	+1·20	+1·16	+1·19	+1·24	+1·23	+1·27
·90	+0·81	+0·77	+0·77	+0·78	+0·81	+0·87	+0·90	+0·91	+1·00	+1·02	+0·98	+1·00
·58	+0·46	+0·40	+0·40	+0·48	+0·52	+0·59	+0·57	+0·61	+0·70	+0·68	+0·71	+0·72
·40	+0·38	+0·38	+0·40	+0·43	+0·36	+0·23	+0·37	+0·40	+0·47	+0·40	+0·48	+0·50
·00	0·00	0·00	0·00	+0·01	+0·10	+0·12	+0·17	+0·20	+0·20	+0·27	+0·32	+0·15
60	−0·57	−0·58	−0·40	−0·32	−0·28	−0·27	−0·22	−0·10	−0·08	+0·08	+0·10	−0·30
48	−0·44	−0·42	−0·40	−0·39	−0·36	−0·30	−0·23	−0·20	−0·16	−0·20	−0·07	−0·28
27	−0·90	−0·77	−0·70	−0·60	−0·50	−0·49	−0·40	−0·38	−0·36	−0·28	−0·24	−0·58
97	−1·70	−1·30	−1·08	−0·98	−0·82	−0·72	−0·67	−0·54	−0·49	−0·49	−0·49	−1·19
02	−1·50	−1·28	−1·20	−1·10	−0·97	−0·86	−0·80	−0·72	−0·70	−0·72	−0·84	−1·34
80	−1·52	−1·32	−1·26	−1·19	−1·10	−0·98	−0·88	−0·82	−0·77	−0·72	−0·70	−1·54
26	−1·90	−1·50	−1·38	−1·29	−1·29	−1·30	−1·28	−1·07	−1·00	−0·80	−0·77	−1·55
52	−1·49	−1·48	−1·40	−1·33	−1·27	−1·16	−1·03	−0·99	−0·90	−0·80	−0·81	−1·53
73	−1·60	−1·51	−1·50	−1·38	−1·23	−1·19	−1·08	−0·98	−0·88	−0·80	−0·98	−1·47
16	−2·00	−1·64	−1·52	−1·30	−1·17	−1·11	−1·16	−1·02	−1·00	−1·10	−1·28	−1·64
60	−1·48	−1·36	−1·30	−1·24	−1·20	−1·15	−1·07	−0·95	−0·90	−0·91	−0·92	−1·57
50	−1·33	−1·24	−1·16	−1·10	−1·00	−0·91	−0·88	−0·82	−0·79	−0·69	−0·67	−1·40
70	−1·40	−1·22	−1·16	−1·02	−0·92	−0·87	−0·82	−0·73	−0·68	−0·61	−0·56	−1·19
60	−1·34	−1·33	−1·32	−1·15	−1·10	−1·00	−0·90	−0·80	−0·72	−0·69	−0·65	−1·09
35	−2·29	−2·20	−1·93	−1·50	−1·13	−1·10	−1·00	−0·90	−0·93	−0·92	−0·98	−1·52
82	−1·62	−1·57	−1·57	−1·38	−1·28	−1·30	−1·27	−1·30	−1·40	−1·57	−1·77	−1·67
58	−2·18	−1·97	−1·90	−1·81	−1·78	−1·61	−1·46	−1·47	−1·28	−1·20	−1·20	−2·21
05	−3·10	−2·97	−2·80	−2·62	−2·32	−1·92	−1·78	−1·58	−1·57	−1·53	−1·59	−2·19
47	−3·47	−3·49	−3·47	−3·47	−3·15	−2·78	−2·60	−2·60	−2·68	−2·84	−2·96	−2·88
55	−3·25	−2·96	−2·40	−2·16	−2·02	−1·88	−1·72	−1·80	−1·95	−2·05	−2·13	−2·88
75	−3·80	−3·65	−3·55	−3·47	−3·40	−3·35	−3·30	−3·25	−3·20	−3·10	−3·20	−3·26
95	−4·03	−4·02	−4·06	−3·92	−3·82	−3·68	−3·65	−3·49	−3·53	−3·47	−3·45	−3·68
15	−4·90	−4·74	−4·58	−4·40	−4·33	−4·30	−4·20	−4·06	−4·03	−4·00	−3·88	−4·45
19	−1·284	−1·173	−1·066	−0·983	−0·884	−0·808	−0·732	−0·675	−0·643	−0·621	−0·648	−1·031

Digitized by Google

Digitized by Google

Digitized by Google

TABLE

AZIMUTHAL ERRORS OF THE

Year.	Jan. 1.	Jan. 15.	Feb. 1.	Feb. 15.	Mar. 1.	Mar. 15.	Apr. 1.	Apr. 15.	May 1.	May 15.	June 1.	June 15.	July
	s	s	s	s	s	s	s	s	s	s	s	s	
1856	−0·20	−0·17	−0·18	−0·18	−0·14	−0·04	−0·05	+0·10	+0·10	+0·10	−0·18	−0·13	−0
1857	(−0·22)	−0·27	−0·23	−0·25	−0·23	−0·16	−0·02	−0·06	−0·08	−0·28	−0·20	−0·07	−0
1858	−0·29	−0·23	−0·21	(−0·22	−0·21	−0·16	0·00	+0·03	+0·05)	−0·15	−0·12	0·00	(−0
1859	−0·28	−0·22	−0·22	−0·20	−0·17	−0·15	+0·07	+0·17	+0·38	+0·40	+0·10	−0·03	−0
1860	−0·27	−0·26	−0·22	−0·02	(+0·12)	+0·25	+0·50	+0·63	+0·67	+0·40	+0·25	+0·10	+0
1861	+0·18	(+0·25	+0·35)	+0·60	+0·80	+0·80	+0·90	+1·00	+0·95	+0·80	+0·42	+0·27	+0
1862	(+0·26	+0·43)	+0·60	+0·90	+0·93	+1·06	+1·00	+0·95	+0·94	+0·90	+0·83	+0·65	+0
1863	0·00	+0·10	+0·50	+0·72	+0·90	+0·90	+0·96	+0·75	+0·70	+0·45	+0·30	+0·25	+0
1864	(+0·35	+0·45)	+0·60	+0·80	+1·10	+1·35	+1·48	+1·32	+1·50	+1·40	+1·14	+1·04	+0
1865	+0·60	(+1·10)	+1·50	+1·50	+1·60	+1·60	+1·40	(+1·20)	+0·95	+0·90	+0·75	+0·65	+0
1866	+0·96	+1·26	+1·40	+1·10	+0·95	+1·03	+1·13	+1·02	+0·75	+0·74	+0·69	+0·55	+0
1867	+1·20	+1·40	+1·13	+1·07	+1·03	+0·70	+0·65	(+0·40)	+0·18	+0·17	−0·09	−0·09	+0
1868	+0·90	+1·14	+1·24	+1·11	+1·05	+0·90	+0·80	+0·45	+0·30	+0·32	+0·35	+0·22	+0
1869	+0·60	(+0·84)	+1·08	+0·85	+0·65	+0·50	+0·28	+0·20	+0·15	−0·10	+0·35	+0·64	+0
1870	(+0·55	+0·75	+0·95)	+1·36	(+1·20)	+1·03	+1·13	+0·80	(+0·60)	+0·23	+0·12	(+0·26)	+0
1871	+1·01	+1·15	+1·43	(+1·25)	+1·08	+0·95	+0·85	+0·67	+0·56	+0·35	+0·46	+0·30	(+0
1872	(+1·00)	+0·97	+0·92	+0·72	(+0·55)	+0·48	+0·38	+0·38	+0·35	+0·24	−0·22	−0·40	+0
1873	+1·10	+1·20	+1·10	+0·97	+0·85	+0·67	+0·51	+0·44	+0·42	+0·28	+0·30	+0·65	+0
1874	+1·02	+1·36	+1·48	+1·38	+1·30	+1·12	+0·86	+0·82	+0·52	+0·50	+0·45	+0·35	+0
1875	(+1·15)	+1·40	+1·52	+1·70	+1·65	+1·60	+1·50	+1·30	+1·20	+1·10	+1·00	+0·92	+0
1876	+1·21	+1·44	+1·60	+1·50	+1·23	+1·08	+1·00	+0·90	+0·85	+0·82	+0·80	+0·80	+0
1877	+0·99	+1·07	+1·10	+1·04	+0·75	+0·62	+0·53	+0·43	+0·46	+0·50	+0·72	+0·86	+0
1878	+0·70	+0·62	+0·50	+0·48	+0·40	+0·45	+0·55	+0·40	+0·41	+0·53	+0·60	+0·43	+0
1879	+1·10	+1·27	+1·40	+1·45	+1·30	+1·12	+1·10	+1·00	+0·90	+1·00	+0·90	+0·90	+0
1880	+1·42	+1·40	+1·27	+1·15	+1·10	+1·02	+0·85	+0·68	+0·72	+0·60	+0·55	+0·62	+0
1881	+0·85	+0·78	+0·80	+0·72	+0·75	+0·73	+0·70	+0·72	+0·75	+0·75	+0·65	+0·65	+0
1882	+1·35	+1·30	+1·14	+1·02	+0·95	+0·90	+0·85	+0·81	+0·85	+0·80	+0·93	+0·92	+0
1883	+1·05	+1·00	+0·92	+0·95	+1·05	+0·94	+0·92	+0·93	+0·90	+0·94	+0·90	+0·93	+0
1884	+0·96	+0·96	+0·95	+0·84	+0·90	+0·90	+0·93	+0·94	+0·97	+0·92	+1·01	+1·03	+0
Means. 1856 to 1882	+0·64	+0·76	+0·84	+0·83	+0·80	+0·75	+0·74	+0·65	+0·59	+0·51	+0·44	+0·42	+0

Digitized by Google

E II.

E CAPE TRANSIT CIRCLE.

1.	July 15.	Aug. 1.	Aug. 15.	Sept. 1.	Sept. 15.	Oct. 1.	Oct. 15.	Nov. 1.	Nov. 15.	Dec. 1.	Dec. 15.	Means.
s	s	s	s	s	s	s	s	s	s	s	s	s
·12	−0·10	−0·05	−0·08	−0·05	−0·06	−0·09	−0·03	(−0·06)	(−0·09)	(−0·12)	−0·16	−0·08
·07	−0·14	−0·24	−0·15	(−0·20)	−0·22.	−0·26	(−0·24)	(−0·22)	−0·21	−0·27	(−0·28)	−0·19
·08	−0·16)	−0·24	−0·20	(−0·20	−0·22)	−0·23	−0·26	−0·28	(−0·30	−0·30)	−0·30	−0·17
·04	−0·12	−0·14	−0·20	−0·24	−0·15	−0·20	−0·23	−0·24	−0·22	−0·29	−0·30	−0·11
·04	−0·03	−0·08	+0·01	+0·05	0·00	+0·05	(+0·07	+0·05	+0·03	+0·03	+0·12)	+0·10
·25	+0·18	+0·08	+0·04	+0·02	0·00	+0·06	+0·08	(+0·04)	0·00	+0·07	+0·10	+0·34
·40	+0·18	+0·15	+0·18	+0·19	+0·10	+0·07	0·00	0·00	+0·02	−0·01	−0·03	+0·45
·20	+0·20	+0·15	(+0·14)	+0·12	+0·10	0·00	+0·02	+0·05	0·00	(+0·10	+0·20)	+0·33
·75	+0·70	+0·50	+0·40	+0·35	+0·37	+0·30	+0·20	(+0·16)	+0·12	+0·14	+0·32	+0·70
·55	+0·70	+0·55	+0·50	+0·45	+0·37	+0·35	+0·30	+0·22	+0·25	+0·35	+0·50	+0·79
·26	+0·51	+0·50	+0·40	+0·37	+0·30	+0·25	+0·45	+0·38	+0·45	+0·60	+0·95	+0·71
·09	+0·25	+0·35	+0·30	+0·30	+0·37	+0·30	+0·30	+0·29	+0·38	+0·34	+0·50	+0·48
·05	+0·40	+0·45	+0·45	+0·40	(+0·36)	+0·32	+0·32	+0·27	+0·30	+0·35	+0·40	+0·54
·55	+0·62	+0·52	+0·58	+0·58	+0·48	(+0·43)	+0·38	(+0·34)	+0·30	(+0·32)	+0·35	+0·44
·40	+0·47	+0·51	+0·45	(+0·48)	+0·50	(+0·47	+0·44)	+0·40	+0·35	+0·60	(+0·80)	+0·62
·50)	+0·68	+0·75	+0·78	+0·65	(+0·65)	+0·55	+0·70	+0·72	(+0·83	+0·94)	+1·05	+0·79
·49	+0·60	+0·66	+0·80	+0·78	+0·82	+0·77	+0·80	+0·65	+0·62	+0·66	+0·95	+0·58
·84	+0·75	+0·80	+0·70	+0·80	+0·75	+0·80	+0·80	+0·75	+0·76	+0·89	+0·75	+0·75
·94	+1·02	+1·00	+1·04	+1·00	+0·95	+1·00	+0·90	+0·95	+0·93	+0·93	+0·90	+0·95
·95	+1·05	+1·02	+0·95	+0·98	+0·95	+1·00	+0·98	+1·03	+0·97	+0·98	+1·25	+1·17
·55	+0·46	+0·47	+0·70	+0·90	+0·90	+0·92	+0·92	+0·90	+1·02	+1·00	+0·90	+0·95
·86	+0·90	+0·90	+0·98	+0·95	+0·92	+0·97	+1·06	+1·00	+1·00	+0·98	+0·95	+0·86
·60	+0·83	+0·95	+0·98	+0·95	+0·95	+0·95	+0·98	+0·92	+0·97	+0·80	+0·90	+0·70
·95	+0·85	+0·95	+1·00	+1·17	+1·32	+1·20	+1·22	+1·15	+1·26	+1·37	+1·30	+1·13
·63	+0·72	+0·72	+0·74	+0·68	+1·10	+1·22	+1·23	+1·20	+1·15	+1·05	+1·00	+0·95
·76	+1·05	+1·10	+1·10	+1·10	+1·22	+1·23	+1·29	+1·38	+1·42	+1·48	+1·52	+0·98
·90	+0·82	+0·83	+0·85	+0·80	+0·98	+0·98	+1·02	+1·08	+1·06	+1·02	+0·95	+0·96
·96	+0·98	+0·90	+0·93	+1·10	+1·08	+1·11	+1·06	+1·07	+1·08	+1·00	+1·00	+0·99
·95	+1·00	+1·01	+0·99	+0·98	+1·05	+1·03	+1·03	+1·07	+1·10	+1·10	+1·05	+0·99
·45	+0·50	+0·49	+0·50	+0·50	+0·51	+0·50	+0·51	+0·49	+0·50	+0·52	+0·58	+0·58

Digitized by Google

Digitized by Google

Digitized by Google

TABLE

NADIR-POINTS OF THE C

Year.	Jan. 1.	Jan. 15.	Feb. 1.	Feb. 15.	Mar. 1.	Mar. 15.	Apr. 1.	Apr. 15.	May 1.	May 15.	June 1.	June 15.	Ju
	′	′	′	′	′	′	′	′	′	′	′	′	
1856	60·2	59·5	59·6	60·2	59·4	60·3	60·0	60·4	60·6	61·6	61·7	61·6	61
1857	59·7	60·7	60·9	60·3	60·5	61·0	61·9	61·3	61·4	61·9	61·4	61·1	61
1858	59·9	58·9	58·9	59·0	59·4	59·3	60·1	61·2	60·1	57·9	58·1	58·3	57
1859	58·1	59·7	59·8	59·8	60·4	61·6	62·7	63·5	64·9	64·5	62·6	61·9	61
1860	62·3	62·4	61·7	62·6	63·7	64·9	66·6	68·9	69·9	69·8	66·5	64·7	63
1861	63·2	63·7	65·1	66·8	68·1	69·3	69·9	70·1	69·9	69·4	68·5	66·2	64
1862	63·8	65·6	67·5	69·2	70·7	71·6	72·3	72·1	71·1	70·5	69·3	69·2	66
1863	62·8	63·5	65·9	68·3	70·7	73·4	71·8	71·7	71·5	69·2	66·7	65·8	63
1864	61·7	63·0	64·9	67·1	70·2	72·8	74·9	73·3	74·7	74·9	72·4	71·3	70
1865	66·5	69·8	74·2	78·0	79·9	80·6	80·4	79·0	73·7	73·4	69·8	73·3	71
1866	75·7	79·1	82·4	77·8	76·8	82·4	82·4	83·4	80·0	78·7	78·5	76·2	78
1867	79·8	84·2	86·0	84·3	85·8	81·7	82·0	81·4	75·9	71·6	68·2	67·1	71
1868	68·7	74·0	78·1	78·7	81·0	83·5	84·7	83·5	76·0	73·5	71·7	70·4	68
1869	67·3	72·0	77·2	80·8	82·4	84·5	82·0	75·4	76·0	69·6	72·8	72·5	67
1870	67·0	72·0	77·0	82·3	85·5	87·5	88·0	84·8	79·9	73·0	68·0	63·4	68
1871	72·5	77·7	82·0	85·2	85·6	85·5	81·6	82·0	74·6	72·5	69·8	67·7	68
1872	74·0	75·5	75·7	76·0	80·0	80·0	74·5	74·8	75·5	73·0	61·5	64·5	67
1873	71·7	75·2	78·0	78·4	77·0	74·7	74·6	70·4	69·2	65·0	59·0	60·0	66
1874	66·4	66·4	71·0	72·0	71·7	66·6	67·2	64·0	59·9	59·0	58·5	58·0	6
1875	60·0	64·7	71·0	75·6	71·6	72·1	72·0	69·3	67·6	65·6	64·9	62·1	6
1876	59·0	62·8	69·9	70·0	68·6	63·4	59·8	60·6	61·2	59·0	57·0	56·5	5
1877	59·6	60·0	61·4	59·5	59·0	57·5	56·5	55·0	53·8	53·2	58·2	60·5	6
1878	59·6	58·0	56·1	54·5	53·0	51·3	50·8	50·8	50·8	51·5	51·0	50·8	5
1879	58·5	60·1	(61·5)	62·9	62·5	61·5	60·2	59·4	59·3	...	...	...	
1880	...	...	...	...	...	...	60·5	58·9	58·7	57·7	57·6	56·7	5
1881	56·8	54·7	53·0	52·0	51·5	50·5	50·0	50·2	50·5	(51·	55·	60·)	6
1882	59·0	56·8	54·5	52·0	51·2	50·4	49·5	49·5	50·1	51·0	50·5	51·3	5
1883	51·0	50·5	50·1	49·6	49·0	48·9	48·7	48·6	48·5	49·3	50·1	50·0	5
1884	51·2	(50·7	50·3)	49·9	49·5	48·6	48·5	49·0	49·0	49·4	50·0	50·2	5

Digitized by Google

III.

CAPE TRANSIT-CIRCLE.

ly 1.	July 15.	Aug. 1.	Aug. 15.	Sept. 1.	Sept. 15.	Oct. 1.	Oct. 15.	Nov. 1.	Nov. 15.	Dec. 1.	Dec. 15.	Means.
′	′	′	′	′	′	′	′	′	′	′	′	′
1·5	61·4	61·5	61·5	61·5	61·2	61·3	60·7	60·1	60·1	59·8	59·9	60·7
1·7	61·5	61·6	61·2	61·3	61·1	60·8	61·1	60·6	60·3	60·6	60·5	61·0
7·9	58·4	58·2	58·3	58·3	58·2	58·6	58·3	58·3	57·9	58·0	57·9	58·7
1·9	62·5	62·2	63·1	62·8	62·7	62·3	63·0	63·2	63·3	63·0	62·4	62·2
1·7	63·3	63·6	63·4	63·3	63·3	63·4	63·0	63·0	62·5	62·7	62·8	64·3
2·6	64·2	63·6	63·4	63·3	63·2	63·2	62·9	62·7	62·8	62·4	62·4	65·4
5·4	65·3	65·6	65·6	65·3	64·9	65·0	64·5	63·9	63·3	63·0	62·4	67·0
5·0	64·5	64·3	63·8	63·9	63·3	63·6	62·7	61·9	62·0	61·8	61·3	65·8
2·7	70·6	69·7	66·9	65·6	65·0	64·5	63·6	63·1	62·5	62·7	63·5	67·9
·8	76·6	73·6	72·5	71·7	70·9	70·3	69·5	68·8	68·5	69·2	71·2	73·1
3·0	76·1	75·1	74·2	73·2	71·4	70·8	69·5	69·4	70·1	75·0	78·0	76·4
1·8	69·5	65·4	64·7	64·4	63·5	62·9	62·7	62·0	61·9	62·6	63·8	71·8
3·7	73·2	71·9	71·0	69·7	69·1	68·3	67·5	68·2	65·6	64·8	65·0	72·7
·8	67·2	66·1	64·2	63·5	63·0	62·2	62·0	61·8	62·0	62·5	65·2	70·0
3·5	66·7	64·5	63·5	62·7	62·0	62·0	62·0	61·5	61·7	64·1	68·6	70·7
3·6	68·8	69·8	68·7	67·5	66·2	65·7	65·5	66·3	67·6	70·0	72·6	73·1
·5	70·2	70·3	67·5	64·9	63·8	63·1	63·0	63·0	63·7	65·5	68·1	69·8
0·9	59·0	57·6	57·0	56·4	55·7	58·1	57·0	57·8	58·5	60·1	59·8	64·6
·4	61·0	59·5	58·6	57·0	56·6	56·4	55·6	55·1	54·8	54·2	55·4	61·6
0·8	60·6	59·5	59·2	58·0	57·5	57·2	56·7	56·0	55·8	56·0	58·6	63·0
·3	53·7	53·6	61·0	60·3	60·3	59·8	59·7	59·3	59·4	59·7	59·3	60·3
·1	62·0	62·1	62·2	62·2	61·9	62·4	62·6	63·1	63·2	62·5	61·4	60·1
0·4	58·9	57·0	56·6	56·4	56·9	56·9	56·9	56·2	56·5	56·8	57·2	55·1
...	...	...	...	...	...	...	...	...	...	...	...	...
·5	56·6	56·0	56·1	57·5	66·5	67·5	66·5	65·0	62·5	61·0	58·7	...
0·0	63·1	61·0	57·3	57·9	58·5	58·5	59·1	60·7	61·3	62·0	61·5	56·6
0·0	51·0	50·5	50·5	50·7	51·2	50·7	51·5	51·5	51·2	51·0	51·5	51·6
0·0	50·6	51·3	51·2	51·5	52·4	52·1	52·3	52·1	52·0	51·8	51·3	50·5
0·6	50·8	50·6	50·4	50·3	50·0	50·5	50·6	50·7	50·7	50·8	50·3	50·1

Digitized by Google

Digitized by Google

Digitized by Google

TABLE

MONTHLY VALUES O

Year.	January.	February.	March.	April.	May.	June.
	°	°	°	°	°	°
1856	70·56	71·87	66·90	67·68	58·74	56·22
1857	68·96	70·54	67·07	60·88	58·45	54·29
1858	67·84	68·67	67·12	66·02	58·03	56·30
1859	68·13	66·48	66·44	61·74	58·52	55·24
1860	69·26	68·96	65·44	62·31	56·72	53·76
1861	68·76	67·88	67·34	61·96	57·12	55·13
1862	68·25	67·12	65·30	61·91	59·46	56·25
1863	70·29	69·28	64·32	61·92	56·65	53·56
1864	69·17	69·35	66·50	61·06	57·45	53·97
1865	69·82	70·03	68·57	61·51	59·22	57·15
1866	70·18	67·43	67·93	62·22	59·41	54·80
1867	70·58	68·19	65·19	61·24	57·54	55·31
1868	68·81	66·99	64·01	59·76	56·87	54·21
1869	68·84	71·70	66·22	62·60	57·35	56·29
1870	67·50	68·86	64·60	61·73	54·55	55·04
1871	67·82	67·82	65·29	62·00	58·66	54·57
1872	66·92	68·68	65·69	62·38	59·07	54·82
1873	71·14	68·18	66·23	62·22	59·09	55·71
1874	69·27	68·09	66·51	60·44	55·73	53·36
1875	69·95	68·79	66·41	63·23	57·74	53·28
1876	70·40	67·60	64·90	63·50	56·00	55·70
1877	69·00	67·90	68·60	63·30	57·30	56·60
1878	67·60	68·20	65·80	64·60	57·20	55·40
1879	65·90	67·40	64·50	60·70	58·10	54·90
1880	66·50	66·40	64·50	60·50	59·50	56·90
1881	68·28	67·27	65·35	59·88	56·37	55·51
1882	69·50	68·70	66·20	62·00	59·30	55·20
Means.	68·86	68·46	66·03	62·20	57·78	55·17

Digitized by Google

IV.

F TEMPERATURE.

July.	August.	September.	October.	November.	December.	Means.
°	°	°	°	°	°	°
53·29	53·12	57·48	60·53	65·08	66·61	62·34
54·03	56·97	58·66	60·66	66·07	66·35	61·91
52·16	54·97	57·35	60·49	64·45	66·44	61·65
53·23	54·39	57·95	59·36	62·04	66·27	60·86
52·66	59·77	54·32	61·25	63·80	67·33	61·30
55·59	55·49	57·21	62·50	63·06	67·20	61·60
53·87	54·37	55·12	56·16	61·43	68·63	60·66
54·10	54·09	55·66	60·09	61·94	67·92	60·82
54·25	55·63	57·06	60·66	63·43	67·67	61·35
55·43	56·87	58·91	61·01	61·93	68·11	62·38
54·60	55·15	57·56	60·32	64·62	66·09	61·69
55·39	55·73	57·47	59·02	63·90	67·57	61·43
53·96	56·72	56·75	59·55	62·50	66·25	60·53
53·12	55·16	57·90	60·58	63·17	65·14	61·51
53·28	54·06	57·92	61·05	66·53	67·23	61·03
54·37	54·65	60·22	60·74	62·60	66·98	61·31
53·85	55·81	56·26	60·70	62·61	66·81	61·13
55·84	55·13	57·13	59·29	64·78	66·61	61·79
51·30	54·94	58·05	59·48	63·13	67·17	60·62
53·90	54·47	54·66	59·73	64·86	66·09	61·09
55·20	54·60	57·10	61·40	64·40	65·00	61·32
55·90	56·70	58·10	61·80	64·10	65·50	62·07
54·80	54·40	55·40	59·00	63·80	65·00	60·93
54·00	55·90	57·70	60·10	61·00	65·40	60·47
57·80	55·20	56·50	62·20	64·30	67·40	61·48
53·11	54·96	59·39	62·48	61·83	65·85	60·86
55·40	55·80	57·60	58·70	63·60	67·30	61·61
54·24	55·36	57·24	60·33	63·52	66·67	61·32

Digitized by Google

Digitized by Google

Digitized by Google

TABLE V

MONTHLY VALUES OF

Year.	January.	February.	March.	April.	May.	June.
	in.	in.	in.	in.	in.	in.
1856	3·36	0·34	0·94	0·44	3·39	3·06
1857	0·23	0·41	0·13	2·33	2·77	4·56
1858	1·22	0·98	0·83	2·65	0·75	2·98
1859	1·83	0·96	1·05	0·78	6·93	5·46
1860	0·85	1·05	0·64	1·19	6·57	4·96
1861	0·80	0·07	0·87	1·58	4·32	7·61
1862	0·23	0·23	0·37	0·94	1·25	10·78
1863	0·20	0·67	2·91	2·56	5·34	3·21
1864	0·54	0·01	0·29	1·01	2·78	4·37
1865	0·30	0·14	0·39	1·85	3·88	0·93
1866	0·03	3·10	0·19	1·50	0·76	5·66
1867	0·39	1·06	1·06	2·44	3·04	3·54
1868	0·71	1·04	0·47	2·17	1·87	3·36
1869	0·17	0·07	0·55	1·88	8·06	9·52
1870	0·72	0·07	0·16	1·36	4·35	5·24
1871	0·32	0·17	0·97	1·48	3·11	3·84
1872	0·72	0·58	1·39	0·24	6·83	4·64
1873	0·29	0·21	0·56	2·20	3·93	4·99
1874	0·08	0·06	1·48	4·80	1·97	3·12
1875	0·00	1·38	0·72	1·36	1·77	5·68
1876	0·10	0·00	2·26	1·11	3·06	3·63
1877	0·73	1·61	0·56	3·57	13·46	2·73
1878	0·84	1·22	1·56	1·34	7·52	8·18
1879	0·94	0·18	0·84	1·41	2·75	2·17
1880	1·88	0·50	1·05	1·70	1·26	1·64
1881	0·36	0·11	1·03	3·56	6·89	3·27
1882	0·11	0·19	4·43	1·99	2·78	3·29
Means.	0·55	0·61	1·03	1·84	4·13	4·53

Digitized by Google

RAIN-FALL.

July.	August.	September.	October.	November.	December.	Sums.
in.	in.	in.	in.	in.	in.	in.
3·36	2·23	1·59	1·22	1·28	1·27	19·48
3·07	3·98	1·78	1·30	0·26	1·22	22·05
4·28	5·61	2·70	0·73	1·11	0·44	24·27
6·52	4·79	3·22	2·40	2·58	0·21	36·72
4·93	0·92	5·02	2·08	0·24	0·68	29·12
4·30	1·92	2·54	0·11	1·29	0·05	25·44
6·28	4·06	2·24	4·04	1·58	0·00	32·01
2·37	2·68	1·72	2·71	0·92	0·32	25·60
2·68	2·18	1·98	1·96	1·00	0·12	18·92
4·91	1·68	0·65	3·11	0·57	0·27	18·67
2·38	2·27	1·44	1·00	0·40	0·48	19·21
4·34	1·36	1·44	3·53	0·21	0·54	22·97
2·65	0·69	0·90	2·72	2·38	1·00	19·95
3·06	4·12	1·18	1·03	1·29	1·41	32·34
6·74	4·44	1·31	1·77	0·44	1·46	28·06
2·99	3·53	1·16	0·73	0·73	1·09	20·10
2·39	7·68	2·12	0·94	1·09	0·71	29·33
3·24	4·04	1·08	0·84	0·64	1·75	23·77
4·65	3·76	1·56	2·07	2·59	0·08	26·20
1·15	4·09	3·84	2·12	1·30	2·32	25·72
3·50	6·07	1·87	1·12	1·29	2·64	26·64
1·23	3·67	1·62	1·77	3·01	1·61	35·56
7·65	5·03	2·69	3·17	0·99	0·84	41·03
2·83	1·61	2·53	1·33	0·85	1·31	18·75
2·64	3·37	2·42	0·21	0·49	0·55	17·69
2·82	3·54	1·23	1·06	1·44	0·30	25·61
5·32	2·47	2·13	3·07	0·44	3·06	29·28
3·79	3·40	2·00	1·78	1·13	0·95	25·73

Digitized by Google

Digitized by Google

Digitized by Google

TABLE

LEVEL ERRORS OF

Year.	January.	February.	March.	April.	May.	June.
	s.	s.	s.	s.	s.	s.
1834	(+0·70	+0·70)	+0·67	+0·57	+0·47	+0·30
1835	+0·11	+0·13	+0·09	−0·12	+0·03	+0·18
1836	+0·20	+0·30	+0·24	+0·05	+0·15	+0·20
1837	+0·15	+0·15	+0·04	−0·12	−0·44	−0·29
1838	−0·42	−0·42	(−0·41	−0·37)	−0·33	−0·22
1839	+0·06	−0·08	−0·19	−0·05	−0·12	−0·11
1840	−0·08	−0·07	+0·06	+0·34	+0·41	+0·55
1841	+0·38	+0·48	+0·57	(+0·70)	+0·98	+1·22
1842	+0·66	+0·63	+1·00	+1·26	+1·35	+1·53
1843	+1·24	+1·28	+1·23	+1·07	+1·38	+1·53
1844	+1·25	+0·93	+1·25	+1·00	+1·34	+1·32
1845	+1·08	+0·99	+0·51	+0·47	+0·50	+0·54
1846	+0·39	(+0·40)	+0·40	+0·35	+0·45	+0·63
1847	+0·18	+0·23	+0·19	+0·18	+0·63	+0·93
1848	−0·18	−0·31	−0·26	−0·29	−0·34	−0·24
1849	−0·87	−0·69	−0·94	−0·89	−0·57	−0·22
1850	−0·70	−0·67	−0·69	−0·61	−0·53	−0·46
1851	−1·51	−1·73	−1·86	−1·89	−1·23	−0·88
1852	−0·71	−0·74	−0·69	−0·62	−0·44	−0·43
1853	−0·77	−0·93	−1·08	−0·87	−0·68	−0·55
1854	−0·86	−1·02	−1·04	−1·02	−0·92	−0·66
Means.	+0·014	−0·021	−0·043	−0·041	+0·100	+0·232

Digitized by Google

VI.

OLD TRANSIT.

July.	August.	September.	October.	November.	December.	Means.
s.	s.	s.	s.	s.	s.	s.
+0·33	+0·34	+0·34	+0·34	+0·40	+0·28	+0·453
+0·18	+0·22	+0·20	+0·28	+0·30	+0·26	+0·155
+0·17	+0·26	+0·18	+0·32	+0·15	+0·18	+0·200
−0·33	−0·34	−0·33	−0·35	−0·29	−0·31	−0·205
−0·22	−0·18	−0·15	−0·06	−0·09	+0·09	−0·232
−0·04	−0·09	−0·12	−0·20	−0·11	−0·03	−0·090
+0·52	+0·41	+0·35	+0·35	+0·31	(+0·35)	+0·292
+1·18	(+1·10	+0·95)	+0·84	(+0·80)	+0·76	+0·830
+1·55	(+1·50)	+1·45	+1·37	+1·23	+1·14	+1·223
+1·60	+1·57	+1·52	+1·39	+1·38	+1·36	+1·379
(+1·35	+1·30	+1·28)	+1·26	+1·02	+0·91	+1·184
+0·61	(+0·60)	+0·52	(+0·40)	+0·30	+0·39	+0·576
+0·48	+0·42	+0·43	+0·25	+0·29	(+0·25)	+0·312
+1·03	+0·77	+0·62	+0·43	+0·07	−0·04	+0·436
−0·16	−0·29	−0·35	−0·43	−0·58	−0·85	−0·357
+0·09	+0·11	0·00	−0·09	−0·27	−0·70	−0·420
−0·65	−0·71	−0·86	−0·80	−0·18	−1·06	−0·743
−0·45	−0·21	−0·38	−0·47	−0·60	−0·67	−0·990
−0·37	−0·31	−0·21	−0·26	−0·39	−0·51	−0·473
−0·39	−0·38	−0·38	−0·43	−0·53	−0·61	−0·633
−0·58	−0·49	−0·48	−0·55	−0·61	−0·75	−0·748
+0·281	+0·267	+0·218	+0·171	+0·076	+0·021	+0·106

Digitized by Google

Digitized by Google

Digitized by Google

TABL

LEVEL ERRORS OF THE GR

Year.	Jan 1.	Jan. 15.	Feb. 1.	Feb. 15.	Mar. 1.	Mar. 15.	Apr. 1.	Apr. 15.	May 1.	May 15.	June 1.	June 15.
	"	"	"	"	"	"	"	"	"	"	"	"
1851	− 4·4	− 2·7	− 3·5	− 3·1	− 3·5	− 3·7	− 4·5	− 4·0	− 3·6	− 4·7	− 6·0	− 5·3
1852	− 1·2	− 3·1	− 3·0	− 2·2	− 2·4	− 2·4	− 3·0	− 3·2	− 5·0	− 4·2	− 3·7	− 4·0
1853	− 1·9	− 1·1	− 1·1	− 0·8	− 1·2	− 2·0	− 3·0	− 2·2	− 3·4	− 3·0	− 3·0	− 4·0
1854	+ 0·5	− 1·0	− 2·5	− 1·6	− 1·7	− 2·7	− 2·7	− 2·0	− 0·8	− 2·5	− 1·7	− 2·3
1855	+ 1·1	+ 1·8	+ 1·9	+ 1·2	+ 0·5	+ 0·8	+ 1·4	− 1·1	+ 0·4	+ 0·8	0·0	− 0·5
1856	+ 2·2	+ 2·8	+ 2·6	+ 1·5	+ 1·2	+ 2·0	+ 0·5	+ 0·3	+ 1·6	− 0·2	− 1·3	− 0·8
1857	+ 2·6	+ 3·0	+ 3·2	+ 2·0	+ 2·0	+ 2·0	+ 0·8	+ 1·8	+ 2·2	− 1·0	− 0·3	+ 0·4
1858	+ 4·8	+ 4·4	+ 3·5	+ 4·0	+ 3·8	+ 2·8	+ 2·3	+ 1·5	+ 2·3	+ 1·9	− 0·6	− 2·0
1859	+ 5·5	+ 4·9	+ 4·8	+ 3·8	+ 4·3	+ 3·5	+ 4·5	+ 4·7	+ 3·9	+ 3·1	+ 1·5	+ 2·2
1860	+ 5·5	+ 6·6	+ 6·0	+ 6·6	+ 4·8	+ 5·5	+ 3·8	+ 4·5	+ 4·0	+ 2·5	+ 4·1	+ 3·9
1861	+ 6·0	+ 6·5	+ 4·7	+ 5·0	+ 5·0	+ 5·0	+ 4·8	+ 5·3	+ 5·5	+ 4·2	+ 2·3	+ 3·0
1862	+ 7·8	+ 7·2	+ 5·3	+ 6·6	+ 6·7	+ 5·8	+ 5·0	+ 6·1	+ 2·8	+ 5·0	+ 2·1	+ 4·1
1863	+ 6·6	+ 7·7	+ 6·0	+ 8·2	+ 6·0	+ 7·3	+ 7·0	+ 5·5	+ 6·8	+ 6·0	+ 3·8	+ 5·1
1864	+ 9·0	+ 8·2	+ 8·4	+ 8·5	+ 7·5	+ 7·5	+ 7·4	+ 3·7	+ 6·2	+ 5·1	+ 7·3	+ 6·0
1865	+10·0	+ 9·8	+ 9·3	+10·0	+ 8·0	+ 9·2	+ 7·7	+ 6·6	+ 6·5	+ 7·1	+ 6·7	+ 7·2
1866	+11·0	+10·0	+ 9·5	+10·0	+11·0	+10·0	+ 9·0	+ 8·2	+10·0	+ 9·0	+ 8·0	+ 8·0
1867	+12·5	+12·0	+ 9·2	+ 9·4	+11·1	+10·7	+ 8·5	+ 8·5	+ 7·4	+ 9·2	+ 6·0	+ 7·8
1868	+12·0	+ 9·0	+ 8·5	+ 9·0	+ 7·5	+ 8·0	+ 8·3	+ 8·0	+ 6·1	+ 5·6	+ 6·0	+ 5·7
1869	+12·0	+11·0	+10·2	+10·5	+10·0	+10·7	+10·2	+ 6·6	+ 8·8	+ 8·7	+ 9·0	+ 9·0
1870	+10·8	+11·2	+10·0	+11·0	+ 9·0	+ 9·5	+10·0	+ 8·0	+10·0	+ 7·8	+ 7·7	+ 7·0
1871	+11·2	+10·5	+10·9	+ 9·0	+ 9·2	+10·0	+ 9·7	+ 7·7	+ 8·7	+ 9·1	+ 7·9	+ 6·7
1872	+11·0	+10·7	+ 9·8	+ 9·8	+ 9·0	+ 9·1	+ 7·7	+ 7·2	+ 7·4	+ 9·3	+ 7·7	+ 5·4
1873	+10·3	+ 9·9	+10·5	+ 9·7	+ 9·7	+ 9·7	+ 7·7	+ 7·7	+ 7·7	+ 8·2	+ 7·7	+ 7·2
1874	+ 9·8	+ 9·9	+10·1	+ 9·7	+ 8·7	+ 8·3	+ 7·2	+ 8·1	+ 7·9	+ 8·1	+ 6·2	+ 8·7
1875	+11·3	+ 8·4	+ 9·7	+ 9·7	+ 9·7	+ 9·1	+ 7·5	+ 8·8	+ 6·3	+ 5·1	+ 6·7	+ 7·3
1876	+ 7·7	+ 8·5	+ 7·2	+ 6·7	+ 6·7	+ 8·0	+ 6·0	+ 7·7	+ 6·7	+ 7·0	+ 5·4	+ 5·3
1877	+ 7·4	+ 7·7	+ 7·2	+ 6·1	+ 7·7	+ 5·2	+ 4·7	+ 5·7	+ 6·0	+ 4·0	+ 4·4	+ 2·7
1878	+ 7·0	+ 6·3	+ 6·7	+ 5·1	+ 4·7	+ 6·7	+ 6·9	+ 4·5	+ 3·7	+ 3·2	+ 3·7	+ 4·0
1879	+ 6·2	+ 5·7	+ 5·7	+ 4·7	+ 5·5	+ 4·7	+ 3·1	+ 4·9	+ 3·8	+ 2·9	+ 2·7	+ 1·7
1880	+ 2·7	+ 4·7	+ 2·9	+ 3·3	+ 2·6	+ 3·2	+ 2·9	+ 2·1	+ 2·9	+ 0·7	+ 2·0	+ 1·1
1881	+ 3·7	+ 5·0	+ 1·7	+ 3·4	+ 4·3	+ 2·4	+ 2·7	+ 0·1	+ 1·0	0·0	− 1·6	− 0·5
Means.	+ 6·67	+ 6·30	+ 5·66	+ 5·70	+ 5·36	+ 5·35	+ 4·64	+ 4·23	+ 4·32	+ 3·80	+ 3·25	+ 3·23

NOTE.—1870, August 27. Blocks of stone, amounting to one ton in weigh

Digitized by Google

LE VII.

EENWICH TRANSIT-CIRCLE.

July 1.	July 15.	Aug. 1.	Aug. 15.	Sept. 1.	Sept. 15.	Oct. 1.	Oct. 15.	Nov. 1.	Nov. 15.	Dec. 1.	Dec. 15.	Means.
"	"	"	"	"	"	"	"	"	"	"	"	"
− 7·4	− 4·0	− 5·0	− 4·5	− 3·1	− 2·0	− 1·6	− 1·7	− 0·6	− 0·3	− 0·2	− 0·9	− 3·34
− 5·0	− 7·0	− 4·2	− 2·5	− 1·8	− 0·5	− 1·0	− 0·5	− 1·0	− 1·7	− 0·6	− 1·2	− 2·68
− 3·0	− 2·2	− 2·3	− 1·6	− 0·4	− 0·6	0·0	+ 0·6	0·0	+ 0·9	+ 1·5	+ 0·8	− 1·38
− 2·2	− 2·2	− 2·6	− 1·3	− 2·5	− 1·0	+ 0·5	+ 2·6	+ 1·3	+ 2·9	+ 1·6	+ 2·0	− 0·90
− 2·1	− 1·8	− 0·6	+ 0·4	+ 1·5	+ 2·3	+ 1·5	+ 3·2	+ 3·5	+ 3·9	+ 3·8	+ 2·5	− 1·10
− 1·8	− 0·3	− 1·9	− 0·5	+ 1·4	+ 2·0	+ 3·4	+ 2·9	+ 3·7	+ 4·7	+ 4·5	+ 2·8	+ 1·39
− 1·0	− 0·5	+ 1·0	+ 2·4	+ 2·5	+ 3·7	+ 3·8	+ 4·8	+ 5·4	+ 5·6	+ 5·7	+ 4·7	+ 2·37
+ 2·0	+ 1·3	+ 3·0	+ 2·8	+ 5·2	+ 3·3	+ 5·4	+ 5·0	+ 6·4	+ 6·3	+ 5·0	+ 4·9	+ 3·30
+ 2·5	+ 1·4	+ 2·9	+ 5·0	+ 6·8	+ 7·7	+ 6·4	+ 7·0	+ 7·2	+ 8·3	+ 7·5	+ 8·5	+ 4·91
+ 3·3	+ 2·8	+ 4·1	+ 4·4	+ 4·6	+ 5·3	+ 6·0	+ 6·6	+ 6·0	+ 6·9	+ 6·6	+ 6·8	+ 5·05
+ 3·8	+ 4·8	+ 5·0	+ 4·2	+ 5·8	+ 7·3	+ 7·2	+ 6·4	+ 8·3	+ 9·1	+ 8·0	+ 6·9	+ 5·59
+ 4·5	+ 4·6	+ 3·5	+ 5·0	+ 6·1	+ 6·0	+ 5·5	+ 6·1	+ 7·9	+ 8·3	+ 7·5	+ 8·0	+ 5·73
+ 6·0	+ 5·5	+ 7·0	+ 6·0	+ 7·8	+ 7·9	+ 7·9	+ 8·6	+ 9·5	+ 8·7	+ 8·8	+ 8·7	+ 7·02
+ 6·4	+ 6·4	+ 6·0	+ 7·8	+ 8·0	+ 9·3	+10·2	+ 9·5	+10·5	+10·0	+ 9·8	+10·8	+ 7·89
+ 7·9	+ 7·3	+ 8·4	+ 9·0	+ 9·0	+ 8·8	+10·0	+11·0	+11·5	+11·0	+11·7	+11·2	+ 8·96
+ 7·0	+ 6·3	+10·2	+ 9·5	+10·5	+11·0	+10·0	+11·5	+10·9	+11·5	+11·4	+10·6	+ 9·75
+ 6·5	+ 7·5	+ 8·8	+ 5·9	+ 7·5	+10·0	+10·3	+ 9·6	+ 9·2	+10·5	+11·7	+10·0	+ 9·20
+ 7·5	+ 6·1	+ 9·0	+10·2	+10·2	+12·5	+12·5	+12·0	+12·2	+12·0	+12·2	+11·5	+ 9·23
+ 8·3	+ 6·2	+ 8·8	+ 9·7	+11·0	+10·0	+10·5	+11·4	+12·0	+11·5	+12·5	+11·6	+10·00
+ 9·3	+ 7·7	+ 9·4	+10·5	+11·0	+11·3	+11·0	+11·7	+11·6	+12·0	+12·5	+10·7	+10·03
+ 7·7	+ 5·7	+ 8·7	+ 7·2	+ 9·4	+10·1	+11·7	+11·9	+11·7	+11·7	+11·6	+10·2	+ 9·50
+ 7·3	+ 7·7	+ 8·2	+ 9·7	+ 9·7	+ 9·2	+11·0	+12·4	+10·8	+13·1	+11·0	+11·2	+ 9·39
+ 6·5	+ 8·0	+ 7·0	+ 7·8	+ 8·7	+10·3	+10·1	+11·4	+11·0	+11·0	+10·2	+11·0	+ 9·13
+ 6·7	+ 5·3	+ 7·9	+ 9·2	+ 8·2	+10·2	+ 9·5	+10·2	+10·3	+11·7	+10·2	+11·7	+ 8·89
+ 6·1	+ 7·2	+ 7·4	+ 5·6	+ 7·7	+ 8·2	+ 9·7	+11·2	+10·1	+ 9·5	+10·5	+ 9·0	+ 8·53
+ 4·2	+ 3·5	+ 7·2	+ 3·9	+ 8·5	+ 9·5	+ 8·3	+ 8·3	+10·2	+ 6·7	+ 9·1	+ 8·7	+ 7·12
+ 4·0	+ 3·7	+ 4·2	+ 4·5	+ 6·7	+ 5·7	+ 7·4	+ 7·0	+ 7·2	+ 7·9	+ 7·5	+ 7·7	+ 5·95
+ 2·0	+ 3·7	+ 4·7	+ 4·3	+ 5·0	+ 6·7	+ 6·2	+ 7·2	+ 8·2	+ 7·1	+ 7·3	+ 7·7	+ 5·53
+ 2·7	+ 2·4	+ 0·7	+ 1·7	+ 3·4	+ 3·0	+ 4·2	+ 5·5	+ 4·9	+ 6·2	+ 6·7	+ 5·0	+ 4·04
− 0·7	+ 0·1	+ 1·7	+ 0·7	+ 0·9	+ 3·2	+ 3·4	+ 5·0	+ 5·7	+ 4·2	+ 3·9	+ 3·7	+ 2·73
− 2·0	− 3·1	+ 1·1	+ 2·2	+ 3·2	+ 3·4	+ 4·4	+ 4·7	+ 5·2	+ 3·7	+ 4·4	+ 4·5	+ 2·24
+ 3·13	+ 3·03	+ 4·17	+ 4·49	+ 5·56	+ 6·27	+ 6·65	+ 7·18	+ 7·43	+ 7·55	+ 7·53	+ 7·15	+ 5·36

were placed on the western pier: they were removed on November 19.

Digitized by Google

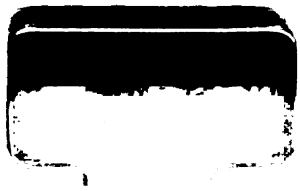
Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google

Digitized by Google



Digitized by Google

Digitized by Google